THE DENTAL PRACTITIONER

AND DENTAL RECORD

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VOL. IX, No. 8 April, 1959

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THE DENTAL PRACTITIONER
AND DENTAL RECORD

Vol. IX, *No.* 8 **CONTENTS** *April*, 1959

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THE DENTAL PRACTITIONER AND DENTAL RECORD

Vol. IX, No. 8 April, 1959

EDITORIAL

THE DENTIST AND ORAL CANCER

THIS year the Imperial Cancer Research Fund is launching—has, in fact, already done so, as many of the dental profession are aware—an all-out appeal for funds to aid in the tremendous task of building, adjoining the Royal College of Surgeons, the most advanced Cancer Research centre in Europe.

This is to be a centre where "there will be brought together all the knowledge, experience and skill gained through many years, and where the facilities and equipment essential to the modern needs of research will be available".

That we, as a profession, should support this great venture financially needs no stressing.

What we, as a profession, can do in our surgeries towards the early discovery of cancer among our patients is something that is often unrecognized. Until the day when cancer's cause and cure have been conclusively established, it is on the early diagnosis of the disease that many sufferers' lives depend. And when it is realized that approximately seven thousand people in the United States die from neoplasms of the oral regions every year, the dentist's responsibility to his patients swings even more forcibly into focus.

Most people in this country consult the dentist more or less regularly. Thus the practitioner has the chance of making an examination more frequently than the physician, who is only consulted when definite symptoms become apparent. He, in any case, is less familiar with the normal oral anatomy than the dentist and could well, solely because of this, overlook an early cancerous lesion.

The dentist, therefore, would be well advised habitually to make a thorough examination of the soft tissues of the mouth during his routine dental check-up. The lips, cheeks, gingivæ, floor of the mouth, tongue, palate, pillars of the fauces, and the throat are all areas for potential neoplastic conditions. Any lesion of apparently non-dental origin must be suspect. And any such lesion referred immediately for expert advice—and treatment.

If it proves malignant and any radical treatment is necessary, then the dentist can play his part in the patient's rehabilitation. In collaboration with the plastic surgeon, ear, nose, and throat surgeon, and the speech therapist, he can create a prosthesis which helps to restore normal facial contours, normal breathing, deglutition, and speech.

The dentist can be the vital link between the life and death of a patient. Never let him, therefore, underestimate his responsibilities.

(Contributions to the Imperial Cancer Research Fund should be sent to the Royal College of Surgeons, Lincoln's Inn Fields, London, W.C.2. All subscriptions go directly towards the actual cost of research: salaries of scientific workers, purchase of equipment, and the laboratories' general running costs.)

AN EXPERIMENTAL INVESTIGATION INTO THE EFFECT OF DENTAL INSTRUMENTS ON THE ENAMEL

By **ERUCH B. FANIBUNDA,** B.Sc., B.D.S., F.D.S. R.C.S. (Eng.), F.R.P.S.
Department of Pathology, Institute of Dental Surgery, Eastman Dental Hospital

Ever since G. V. Black laid down the basic principles of operative dentistry, it has been customary in the dental schools to teach students the necessity of finishing the enamel margins during conservative procedures with chisels and margin trimmers. However, conflicting evidence has appeared from time to time in the dental literature regarding the use of chisels and margin-trimmers.

Stephan (1928) recommended the use of stones and finishing burs in preference to hoes and chisels for finishing the enamel margin. However, Gillett and Irving (1932) have shown that grinding stones do not have any advantages over the chisel or its equivalent.

In agreement with Gillett and Irving, McGehee, True, and Inskipp (1956) found practically no difference in the smoothness of enamel walls prepared with plain fissure burs and chisels. They have recommended chisels for cleaving, bevelling, and planing enamel margins.

Black (1936), Davis (1945), Gabel (1954), and Parfitt and Herbert (1955) have recommended the use of chisels, hoes, and gingival margin-trimmers for planing and bevelling of the enamel walls. In addition, Black also advised the use of fine carborundum stones for finishing enamel walls.

Contrary to these observations and opinions, Street's (1953) experiments have shown that chisels produce a very rough enamel surface, and that a smooth surface is produced by fine sand-paper disks. Peyton and Mortell (1956) have found that "in general the hand instruments do not seem to present a superior surface to that resulting from rotary instruments". However, they have also pointed out that the surface produced by chisels is considerably influenced by the ability of the operator.

The type of instrument most suitable for finishing the enamel margins appears mainly to have been a matter of opinion based on clinical experience rather than experimental evidence. The purpose of the present investigation was to determine experimentally the effect of dental instruments on the enamel under simulated clinical conditions.

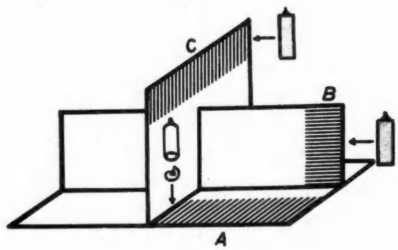


Fig. 1.—A diagrammatic representation of the direction of enamel prisms as found in the enamel walls during cavity preparation. The short parallel lines represent the prisms and show their orientation in relation to the working surfaces of the rotary instruments. The prisms are horizontal in plane (A) and this plane is represented on the tooth by the gingival floor of a proximal box preparation. In plane (B) the prisms run horizontally but lie in a vertical plane; this is represented on the tooth by the buccal or lingual walls of a proximal box preparation. The prisms are vertical in plane (C), which is represented on the tooth by the enamel walls of a proximal box preparation.

In the crown of the tooth the enamel prisms are radially disposed, but for practical purposes they can be considered to lie mainly in three planes at right angles to each other. In *Fig.* 1 these planes are related to the positions in which they are encountered in standard cavity preparations. As special instruments have been designed to finish the different enamel walls related to the position of these planes, it was thought that if a comparison was to be made between the effects of various

instruments, then it was fair to do so only if these instruments were designed to work on the same wall of a cavity preparation. For example, it is useless to compare the effects on the enamel walls of a cervical margin trimmer with those of a sand-paper disk, because in standard clinical practice the sand-paper disk cannot be substituted for the margin trimmer to finish a proximal gingival floor.

Therefore, it was decided to group the investigations according to the different positions of the enamel walls as represented by the planes shown in *Fig.* 1.

Group I.—The effects of instruments used for cutting the gingival floors of proximal box preparations (*Fig.* 1 A).

Group II.—The effects of instruments used for cutting the buccal and lingual or palatal walls of a proximal box preparation (*Fig.* 1 B).

Group III.—The effects of instruments used for cutting the enamel walls of an occlusal box preparation (*Fig.* 1 C).

Group IV.—The effects of instruments used for the preparation of proximal slices.

METHOD OF INVESTIGATION

The instruments were selected from those most generally used in standard operative

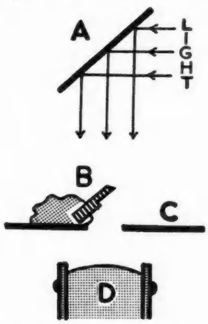


Fig. 2.—A diagrammatic representation of the Vickers projection microscope as used for the examination of the enamel edge. The section (B) is supported by plasticine on the microscope stage (C), with the prepared surface facing the objective (D). A is a surface-silvered mirror.

procedures, and at least twelve preparations were finished with each instrument.

Freshly extracted teeth were used; they were kept in physiological saline and the cavities were prepared on a phantom head within 2 days of extraction. The teeth were mounted in plaster models, and the cavities were prepared in exactly the same way as they would be in the mouth, intermittent water-spray being used to prevent heating

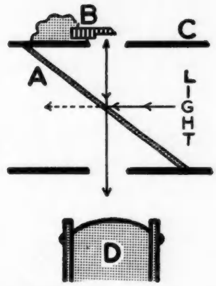


Fig. 3.—A diagrammatic representation of the Vickers projection microscope as used for the examination of the enamel surface. The section (B) is supported by plasticine on the microscope stage (C). A is an optical flat, interposed between the specimen and the objective (D) at an angle of 45°, to provide vertical incident illumination.

and drying. The portions of the tooth on either side of the prepared surface were then sliced off, leaving a section approximately 2 mm. thick. (Sections which were more than 2 mm. in thickness created practical difficulties during the examination of the enamel edge.)

The appearances of the marginal edge and the surface of the enamel were then recorded by photomicrographs with a Vickers projection microscope, care being taken to standardize the technique throughout the investigation. All photographs have been magnified $\times$ 21.

1. Examination of the Marginal Edge.—The section was supported on the microscope stage by plasticine in such a way that the prepared surface was towards and at an angle of about 45° to the objective (*Fig.* 2)—the exact angle depending on the position in which maximum detail was visible. Back lighting was used so that the enamel edge appeared in silhouette against a light background.

2. Examination of the Surface.—Candle soot mixed with absolute alcohol was applied to the prepared enamel surface with a brush. The enamel surface was then wiped with the

smooth side of a piece of adhesive cellulose tape wrapped round the end of a plastic instrument, the wiping being repeated, with fresh pieces of tape, until no more soot could be removed. (Modification of Street's (1953) method.) The enamel surface was thus wiped clean except in those areas where defects retained the soot. Each specimen was then examined by vertical incident illumination (*Fig.* 3).

It was found that if oblique incident illumination was employed, the shadows cast by the defects on the surface falsified the picture.

GROUP I.—THE EFFECT OF INSTRUMENTS EMPLOYED FOR FINISHING THE PROXIMAL GINGIVAL FLOORS OF CLASS II AND III PREPARATIONS

(End-cutting bur Nos. 958 and 960, cross-cut fissure bur Nos. 3 and 5, tapered diamond Dendia No. 13, margin-trimmers 77/78, 79/80 (Ash).)

Proximal box preparations were made in premolar and molar teeth. After the cavities had been prepared, the gingival enamel surface was finished with the instrument under investigation.

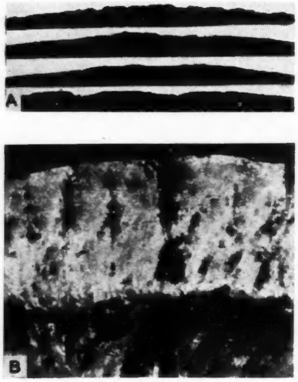


Fig. 4.

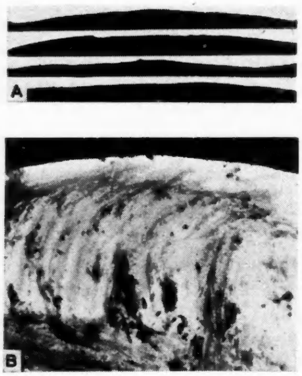


Fig. 5.

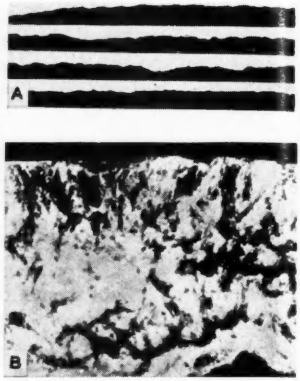


Fig. 6.

Fig. 4.—A, Crenated gingival enamel edges. End-cutting bur Nos. 958 and 960. B, Gingival enamel floor. End-cutting bur No. 958. Compare with *Figs.* 5 B and 6 B.

Fig. 5.—A, Gingival enamel edges with very few crenated areas. Cross-cut fissure bur Nos. 3 and 5. B, Gingival enamel floor. Cross-cut fissure bur No. 5.

Fig. 6.—A, Crenated gingival enamel edges. Dendia diamond No. 13. B, Gingival enamel floor. Dendia diamond No. 13. Note the deep scratches, interwoven with each other.

Results.—*Figs.* 4–7 show the different types of edges and surfaces produced by the instruments.

Edge.—The tapering diamond (*Fig.* 6 A) and the end-cutting bur (*Fig.* 4 A) produced crenated edges, the crenations being more marked in the case of the diamond.

The cross-cut fissure bur (*Fig.* 5 A) produced a smoother edge than the end-cutting bur. Wherever the instruments had slipped over the gingival margin, especially when a small bur had been used, the edge appeared to be broken in the form of rough projections or a large concavity.

The manner in which a bur or other similar rotating instrument was held against the enamel made a marked difference to the type of edge produced. If the cutting edge of the instrument was held in such a manner as to leave unsupported enamel prisms, then the loss of prisms during subsequent manipulations produced a rough, ragged edge.

The margin-trimmers (*Fig.* 7 A) produced smooth undulating edges, sometimes with an occasional sharp notch, the notch being created

by the sudden arrest of the sharp blade against an existing irregularity on the surface of the enamel.

The method of manipulating margin-trimmers may vary with different operators. The

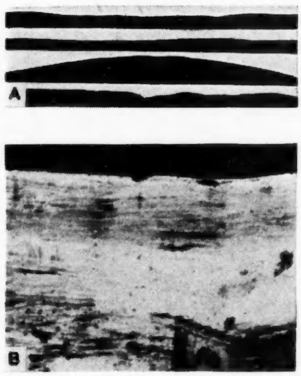


Fig. 7.—A, Smooth undulating gingival enamel edges. Margin-trimmers 77/78, 79/80 (Ash). Note the notching of the edge in the lowermost specimen, produced by a sudden arrest of the margin-trimmer. B, Gingival enamel floor, margin-trimmer 77/78. Note the faint linear markings produced by the irregularities in the blade of the margin-trimmer.

conventional method is one wherein the cutting is done by a combination of scooping and horizontal strokes, with the bevel of the trimmer towards the enamel surface. This method produced smooth margins with slight notching. If, however, the trimmer was used with a very light scraping action with the bevel away from the enamel surface, as suggested by Black (1936), there was less notching, provided the instrument was freshly sharpened and the cavity wiped clean of surplus moisture. Throughout this investigation the margin-trimmers have been used in this manner, as they produced a smoother finish than when used in the conventional way.

Surface.—With margin-trimmers a very smooth enamel surface was obtained (*Fig.* 7 B). Rotary instruments produced a circular whorled pattern in areas where they had not been moved to and fro along the gingival floor. The diamond produced the roughest surface of the three rotary instruments (*Fig.* 6 B). Deep sweeping scratches, interwoven with each other, were left all along the surface, and whenever a scratch reached the edge of a cavity the enamel was broken to leave a notch in the margin. The end-cutting bur produced a smoother surface than the diamond (*Fig.* 4 B), whilst the fissure bur produced a smoother surface than the end-cutting bur, but slightly rougher than that of the margin trimmer (*Fig.* 5 B).

GROUP II.—THE EFFECT OF INSTRUMENTS EMPLOYED FOR FINISHING THE BUCCAL AND LINGUAL OR PALATAL WALLS OF PROXIMAL BOX PREPARATIONS

(Cross-cut fissure bur Nos. 1 and 3, tapered diamond Dendia No. 13, margin-trimmers 77/78, 79/80.)

Proximal box preparations were made in molar and premolar teeth. After the cavity had been prepared, the buccal and lingual or palatal cavity walls were finished with the instrument under investigation.

Results.—*Figs.* 8–10 show the different types of edges and surfaces produced by the instruments.

Edge.—The cross-cut fissure bur produced a slightly crenated edge, having a very irregular contour (*Fig.* 8 A). This irregularity was due to the breaking of small groups of enamel prisms from the periphery of the enamel. The diamond, on the other hand, produced a deeply crenated edge, with a more or less straight contour (*Fig.* 9 A).

The margin-trimmers, used in the manner already indicated, produced the smoothest edge of all (*Fig.* 10 A).

Surface.—The surface markings left by rotary instruments were in the same direction as the enamel prisms. The roughness produced by a cross-cut fissure bur varied in appearance from the dentino-enamel junction towards the edge of the cavity. Most of the enamel wall near the dentino-enamel junction was roughened with shallow pits, some of which were irregular, while others were oblong or drawn out into scratches running in the direction of the prisms (*Fig.* 8 B). In some instances the whole length of the surface was grooved by the head of the bur rotating in the same place for a sufficient period of time. The surface near the edge was found to be

highly irregular, with deep concavities produced by the breakage of enamel prisms in groups (top right corner of *Fig.* 8 B).

The diamond instrument left a uniformly rough surface. Most of the enamel was marked with fusiform scratches running parallel to each other and in the direction of the prisms. In places, where the scratches overlapped each other, an irregular rough patch was produced (*Fig.* 9 B). Areas of enamel unaffected by the deep fusiform scratches had a few thin markings and pits.

The margin-trimmers left a relatively smooth surface, with very few shallow, rough areas, having an irregular outline. In some parts parallel shallow lines were produced by the chattering of the blade on the enamel. Extremely fine markings were found in some instances running at right angles to the direction of the prisms. These were produced by the slight imperfections left in the chisel edge after sharpening (*Fig.* 10 B).

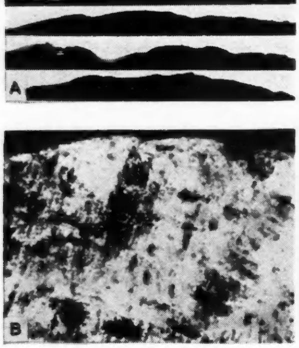


Fig. 8.

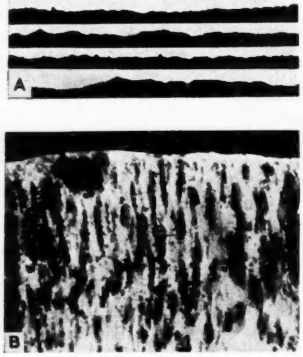


Fig. 9.

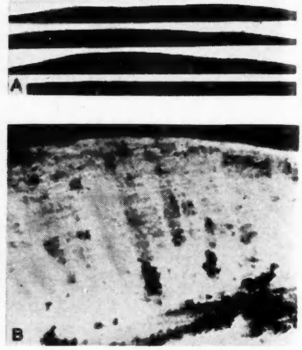


Fig. 10.

Fig. 8.—A, Crenated enamel edges of buccal and lingual walls of proximal box preparations. Cross-cut fissure bur Nos. 1 and 3. B, Enamel surface of a buccal wall from a proximal box preparation. Cross-cut fissure bur No. 3. (Note the deep concavity near the top right corner, produced by the breakage of enamel prisms in groups.)

Fig. 9.—A, Crenated enamel edges of buccal and lingual walls of proximal box preparations. Dendia diamond No. 13. B, Enamel surface of a palatal wall from a proximal box preparation. Dendia diamond No. 13.

Fig. 10.—A, Smooth enamel edges of buccal and lingual walls of proximal box preparations. Margin-trimmers 77/78, 79/80. B, Enamel surface of a buccal wall from a proximal box preparation. Margin-trimmer 79/80. Note the faint linear markings produced by the irregularities in the blade of the margin-trimmer.

GROUP III.—THE EFFECT OF INSTRUMENTS ON THE OCCLUSAL ENAMEL DURING THE CUTTING OF CLASS I PREPARATIONS

(Cross-cut fissure bur Nos. 3 and 5, tapered diamond Dendia No. 13.)

Class I box preparations were made in premolar and molar teeth, the entire cavity preparation being carried out with the instrument under investigation.

Results.—*Figs.* 11 and 12 show the different types of edges and surfaces produced by the instruments.

Edge.—The cross-cut fissure bur produced a smooth edge, marred only by occasional slight irregularities (*Fig.* 11 A). The gross contour of the edge was not affected by the bur, but was governed by the anatomical features of the crown. The diamond instrument produced its typically crenated edge with sharp projections, but the crenations seemed to be slightly smaller than those found in the previous experiments (*Fig.* 12 A).

Surface.—The cross-cut fissure bur produced a smooth surface with scattered, small irregular rough areas (*Fig.* 11 B). If the bur had remained stationary in the same place for some time, then a vertical groove was left on the enamel wall. The cylindrical diamond left a very rough surface marked by fusiform scratches running at right angles to the enamel prisms (*Fig.* 12 B). An end-to-end overlapping of these scratches produced a rough line running right across the enamel prisms, whereas overlapping in other directions gave rise to irregular rough patches.

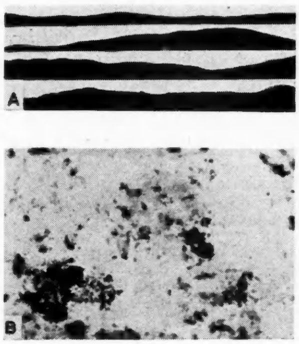


Fig. 11.

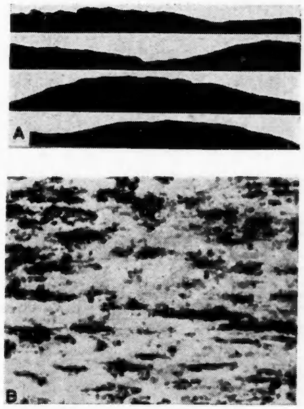


Fig. 12.

Fig. 11.—A, Occlusal enamel edges. Cross-cut fissure bur Nos. 3 and 5. B, Enamel surface of an occlusal box preparation. Cross-cut fissure bur No. 5.

Fig. 12.—A, Occlusal enamel edges. Dendia diamond No. 13. B, Enamel surface of an occlusal box preparation. Dendia diamond No. 13.

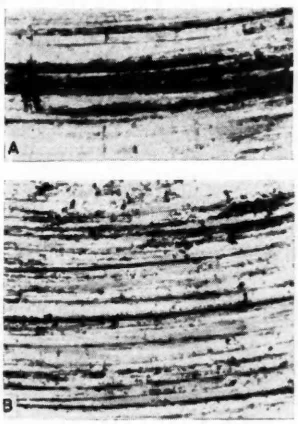


Fig. 13.

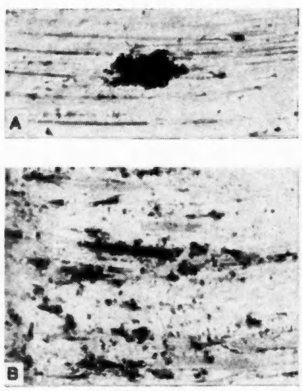


Fig. 14.

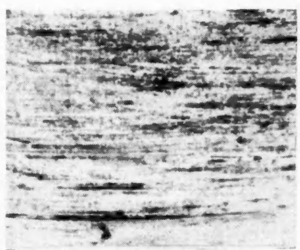


Fig. 15.

Fig. 13.—A and B, Enamel surface of a proximal slice preparation. Diamond disk. Note the groove running across the preparation in (A).

Fig. 14.—A and B, Enamel surface of a proximal slice preparation. Carborundum disk. Note the large rough patch in (A).

Fig. 15.—Enamel surface of a proximal slice preparation. Steel disk charged with fine abrasive.

GROUP IV.—THE EFFECT OF INSTRUMENTS USED FOR PREPARING PROXIMAL SLICES

(Diamond disk, carborundum disk, steel disk charged with abrasive.)

Results.—*Figs.* 13–15 show the different types of surfaces produced by the instruments.

As would be expected of rotating disks, all three instruments produced scratches sweeping across from one edge of the preparation to the other. The main differences were in the width and type of the scratches. These could be divided into: (1) deep scratches; (2) shallow line markings running between the deep scratches; and (3) rough irregular areas varying in size and depth.

The diamond disk produced a very rough surface marked with deep, wide scratches and scattered irregular small pits between the scratches (*Fig.* 13 B). In places where the scratches overlapped each other side by side, they merged to form a wide groove running across the preparation (*Fig.* 13 A).

The carborundum disk produced a smoother surface than the diamond disk. The scratches were fewer in number, relatively thinner, and more widely spaced in many instances. However, the scattered areas of irregular rough pits between the scratches were slightly larger and occasionally a very large one was encountered (*Fig.* 14 A). These large rough patches were recorded in only 2 out of 12 specimens. The major portion of the preparation was occupied by the shallow surface markings between the scratches (*Fig.* 14 B).

The steel disk (charged with abrasive) produced the smoothest surface (*Fig.* 15). The scratches were very fine and shallow. The irregular rough areas were very small and fewer in number than those produced by the carborundum disk; there were no deep scratches.

MECHANISM RESPONSIBLE FOR THE PRODUCTION OF ROUGH ENAMEL EDGES AND SURFACES

The rough enamel edges and surfaces are the end products of mechanical friction between two objects, enamel (with its physical properties of extreme hardness and brittleness) and an instrument which depends for its function and maintenance on an operator. Thus the three factors involved in the mechanism are: (1) the enamel; (2) the instrument; (3) the operator.

The Enamel and the Instrument.—The instruments employed in these experiments can be divided into two main groups on the basis of their mechanism of action: (1) grinding instruments; (2) cutting instruments.

The main difference between the surfaces produced by these two kinds of instruments is that in the case of the former the degree of roughness is determined by the surface of the instrument, whereas in the latter it is determined by the size of prism groups dislodged or fractured by the instrument. For example, a rough grit carborundum wheel-stone will produce a rough enamel surface, and a smooth sand-paper disk will produce a smooth enamel surface under exactly similar conditions, quite independently of any influence which the normal enamel structure may exert. In other words, the surface of the grinding instrument will determine the roughness of the surface of the enamel. A sharp hatchet or an end-cutting bur (whose blades are comparable to eight chisels mounted on a circular flat plane) are examples of cutting instruments. The smoothness of the enamel surface with cutting instruments is mainly governed by the direction of the enamel prisms and the related position of the cutting blade. Thus the instrument may be quite sharp in all cases, but the degree of roughness is determined by the size of the prisms groups dislodged or fractured, which in turn is influenced to a large extent by the direction of the enamel prisms.

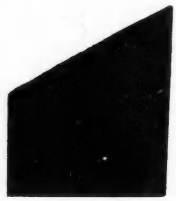


Fig. 16.—The edge of a freshly sharpened margin-trimmer.

The margin-trimmers, when used in the conventional way, cut the enamel by fracturing

the prisms and cleaving them along the interprismatic substance. However, when used with a light scraping action, as previously described, they no longer behave as cutting instruments but act as grinding instruments. It has already been mentioned that, in the case of grinding instruments, the resultant direction of rotation of the instrument in relation to the direction of the enamel prisms. This can be explained if the diamond is regarded mainly as a grinding instrument having a minimal cutting action. Therefore, when preparing the buccal or lingual walls of a proximal box preparation, it will produce deep

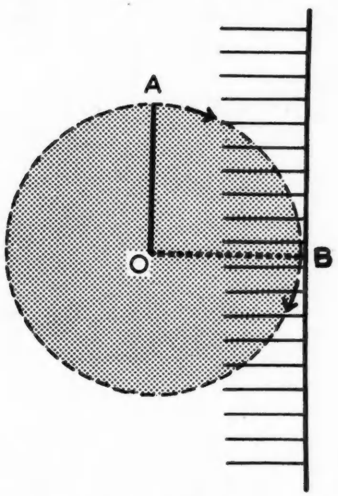


Fig. 17.—The diagram shows the relationship between the gingival enamel prisms and the blades of an end-cutting or a fissure bur, when the bur is confined within the margin of the cavity. The horizontal parallel lines represent the gingival enamel prisms. O is the central axis of the rotating bur and OA one of the eight blades present on the head of the bur. When the blade (OA) reaches the position (OB) near the edge of the cavity the direction of the prisms is at right angles to the rotational direction of the blade.

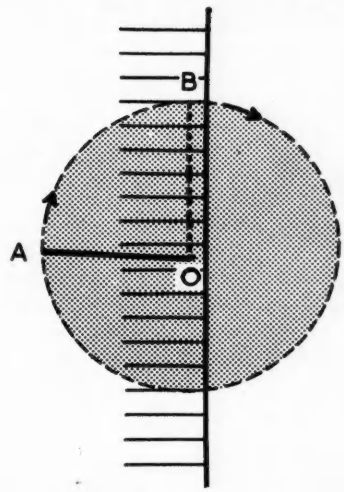


Fig. 18.—The diagram shows the relationship between the gingival enamel prisms and the blades of an end-cutting or a fissure bur when half the diameter of the bur lies outside the cavity margin. O is the central axis of the rotating bur and OA one of eight blades present on the head of the bur. When the blade (OA) reaches the position (OB) near the margin of the cavity, the direction of the enamel prisms coincides with the direction of rotation.

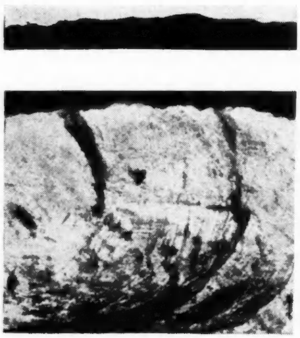
enamel surface will depend on the surface of the instrument. Therefore, a sharp margin-trimmer should theoretically produce a smooth surface. If, however, any irregularities are present in the edge of a margin-trimmer they will be reproduced on the enamel surface. The edge of a margin-trimmer used in this experiment is shown in *Fig.* 16, and *Figs.* 7 B and 10 B show that the surface of the enamel has reproduced to a certain extent the unavoidable slight irregularities in the blade.

The edges produced by the tapered diamond do not seem to be affected by the position or scratches but will not dislodge groups of enamel prisms comparable to those fractured by a fissure bur. A comparison of *Figs.* 8 and 9 illustrates this point.

Proximal slices prepared with abrasive disks have irregular pits on them in addition to the scratches and grooves produced by the particular disk. The mechanisms responsible for the production of these irregular pits are obscure.

The fissure burs have a dual cutting and grinding action on the enamel. The cutting action is mainly limited to the edges of the

cavity, where the enamel is removed by cleavage and fracture of the enamel prisms in groups, and is especially marked when the direction of the enamel prisms coincides with the direction of the rotating blades of the bur (*Fig.* 8). In *Fig.* 11, where the direction of the enamel prisms is at right angles to the direction of the blades, the cutting action is less marked and the finer contour of the edge is comparatively smooth.



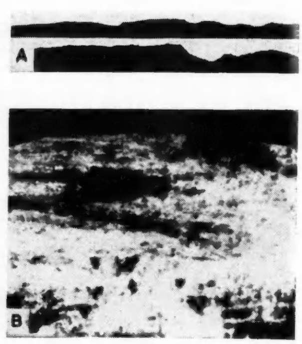


Fig. 19. *Fig.* 20. *Fig.* 21.

Fig. 19.—Gingiva enamel edge and surface. The fissure bur was rotated partly outside the gingival cavity margin as shown in *Fig.* 18.

Fig. 20.—Gingival enamel edge and surface. The fissure bur was rotated within the gingival cavity margin as shown in *Fig.* 17.

Fig. 21.—A, Enamel edges produced as a result of using a blunt margin-trimmer with hard scraping strokes. B, Enamel surface of the bottom specimen shown in (A).

In the case of the gingival edge of a proximal box preparation, the direction of the enamel prisms will vary in their relationship to the rotating blades, according to the position of the bur. In *Figs.* 17 and 18, O represents the central axis of the rotating bur and OA one of the eight blades present on the head of an end-cutting or a fissure bur. The short horizontal lines parallel to each other represent the enamel prisms near the gingival enamel margin of a proximal box preparation. In *Fig.* 17 the bur lies within the edge of the cavity and when blade OA reaches the position OB near the edge of the cavity, the direction of the prisms is at right angles to the rotational direction of the blade. In *Fig.* 18, half the diameter of the bur lies outside the cavity, so that when the blade OA reaches the position OB, the direction of the enamel prisms coincides with the direction of rotation. Judging the behaviour of enamel prisms from existing evidence (*Figs.* 8 and 11), one would expect the gingival enamel prisms to be dislodged and fractured near the edge of the cavity if the bur was rotated as shown in *Fig.* 18.

An experiment was carried out to investigate the behaviour of gingival enamel prisms under conditions shown in *Figs.* 17 and 18. It was found almost impossible to confine the bur accurately within the gingival edge of a proximal box preparation when working under clinical conditions, especially in distal preparations on upper posterior teeth. Therefore, the above experiment was carried out ignoring the clinical conditions, purely for the sake of investigating the relationship. A fissure bur was run half outside the gingival enamel edge and it produced a rough edge (*Fig.* 19). The same bur was then run within the cavity edge and it produced a smooth edge almost as good as that produced by a margin-trimmer (*Fig.* 20). As would be expected, the enamel surface produced by the two methods was similar in appearance (*Figs.* 19 and 20).

It was stated earlier that a fissure bur produced a gingival edge slightly superior to that produced by an end-cutting bur. The reason for this difference was not clear as, according to the manufacturers, the ends of the burs were identical in every respect. Therefore, it was thought that the presence of cutting blades on the side of the head might have been responsible for the slightly superior edge produced by the fissure bur.

The Operator.—The performance of the instruments will depend on the proficiency attained by an individual in their use. This is a variable factor which affects, to a certain extent, the results of these investigations, and should be taken into consideration when assessing the results of similar experiments already published or to be carried out in future.

The use of sharp new burs and the maintenance of a sharp edge to hoes, hatchets, margin-trimmers, etc., has been repeatedly stressed in the past. *Fig.* 21 shows the edge and surface produced by a blunt margin trimmer. A blunt blade tends to break off large groups of enamel prisms leaving a ragged edge, and instead of removing the slight roughness left by a rotary instrument, it creates more irregularities.

DISCUSSION

The varied and contradictory conclusions of previous investigators have led to confusion and created doubts concerning the teaching of certain operative techniques to dental students. This may be attributed to the lack of uniformity amongst the procedures carried out by different authors. The fact that the same instrument is capable of producing varying types of edges and surfaces under different conditions has received insufficient attention. Thus, if one investigator were to run a fissure bur on the gingival floor of a proximal box preparation as depicted in *Fig.* 17 and another were to use it as in *Fig.* 18, the results would be different and might lead to erroneous conclusions. There are many other variable factors, ranging from the angle of holding an instrument and its sharpness to the variables introduced during observation, such as the angle of the specimen on the microscope stage and the technique of making the final photographic print. A variation or an error in just one of these factors is sufficient to produce results, by different investigators, that appear contradictory.

The ideal conditions for carrying out the present investigation would have been in the mouth, but this was a practical impossibility. Therefore, clinical conditions were closely simulated and actual cavities were prepared on a phantom head. The results of previous investigations which did not take account of these factors cannot, necessarily, be applied to clinical operative procedures in the mouth.

The Proximal Gingival Margin.—Previous investigators have mainly concentrated on the enamel surface, which is of lesser importance than the edge of the enamel, i.e., the cavosurface angle of a cavity. Of all the margins present on a Class II preparation the proximal gingival margin deserves special consideration because of its position in an inaccessible situation. The difficulty of access is greatly increased once the restoration is placed in the cavity when, in many cases, it is almost impossible to finish the margin. All the other margins are comparatively easy to reach for purposes of finishing, both during the cavity preparation and after the restoration has been placed. Therefore, the proximal gingival margin stands a greater chance of failure than any other margin, and it may be stated that if all the steps of preparation have been ideally carried out, a Class II restoration or any proximal restoration is as good as its proximal gingival margin.

Ideally, the finished enamel margin should have a smooth edge and surface, and the enamel prisms not supported by sound dentine should have been removed, except where æsthetic considerations demand their preservation in places devoid of strains and stresses (Parfitt and Herbert, 1955).

Of the various instruments at our disposal, the end-cutting or the fissure burs and the margin-trimmers are commonly employed for finishing the gingival margin. As already seen, these three instruments fulfil the requirements of an ideal edge with varying degrees of success. Before a particular instrument can be chosen

as satisfying the above requirements, it would not be amiss to consider the various advantages and disadvantages associated with these instruments.

The results of this investigation have shown that the margin-trimmer produces the smoothest possible edge, and the fact that its blade

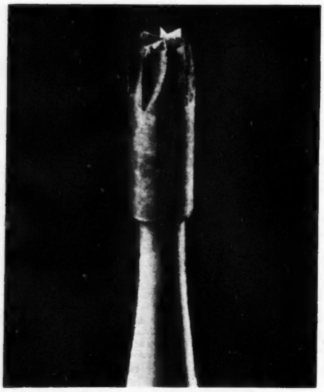


Fig. 22.—End-cutting bur made by the Amalgamated Dental Company to the author's specifications.

can be tilted, or specially ground, to conform to any degree of angulation of the enamel prisms, makes it the instrument of choice for finishing the proximal gingival margin. Also, when working "blind" in certain situations within the mouth, a margin-trimmer is safer to use and gives a much better control and sense of touch than a rotary instrument. However, its application in the mouth is difficult as compared with a bur and after use it immediately needs resharpening, whereas a bur can be replaced. It must also be remembered that a badly applied blunt margin-trimmer leaves a very ragged edge (*Fig.* 21).

For amalgam restorations, slight irregularities left in the gingival edge by a fissure bur are acceptable, because the soft amalgam, if properly condensed against a well adapted matrix band, obliterates these irregularities and ultimately the result would be just as good as that produced by a margin-trimmer. However, the bur must be tilted to conform its cutting plane to the direction of the enamel prisms at the gingival edge. This may not always be possible because of the proximity of an adjacent tooth or because there is likelihood of damage to another restoration. The latter difficulty can be overcome by an end-cutting bur, but it produces an edge inferior to that produced by the fissure bur. The solution

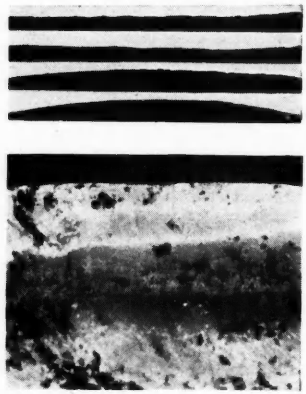


Fig. 23.—Gingival enamel edges and surface produced by the bur shown in *Fig.* 22. Compare with *Figs.* 4 and 5.

may perhaps be sought in a specially designed end-cutting bur having blades on the side of the head extending for a millimetre. Such a bur (*Fig.* 22) was specially made by the Amalgamated Dental Company, and the results obtained with it (shown in *Fig.* 23) are similar to those obtained with a fissure bur. There are burs available with a similar design made by other manufacturers, but their blades extend for a considerable distance up the head, thus defeating their own purpose.

The demands of gold inlay restorations are of a different order and the margin-trimmers cannot be replaced by burs for finishing the gingival edge. Moreover, it is extremely difficult to finish adequately the gingival margin of a M.O.D. inlay if a gingival cavosurface bevel is absent. A very smooth bevel can be given to the preparation only by a margin-trimmer, as the degree of tilt necessary in many cases excludes the use of rotary instruments, unless especially designed cone-shaped points or burs are used.

It has been suggested by Street (1953) that the rough enamel surfaces of cavity walls may aid in the retention of restorations. It is possible that very rough surfaces like those produced by a Dendia diamond No. 13 may give a little extra retention, but the obvious disadvantages of very rough enamel surfaces and their sequelæ outweigh this apparent advantage. Moreover, it might be pointed out that restorations normally depend on specific undercut areas in the dentine and similar other substantial means for their retention.

The sand-paper disks were excluded from this experiment because their flexible nature and the presence of moisture in the mouth severely limits their use as finishing disks for enamel margins and surfaces.

CONCLUSIONS

The following conclusions can be drawn from the present investigation:—

1. The orientation of the blade of a cutting instrument in relation to the direction of enamel prisms plays an important role in deciding the type of edge and surface produced on the enamel.

2. The edge and surface produced by a grinding instrument depend on the surface of the instrument and are not affected by the direction of the enamel prisms. Modern diamond instruments have rough surfaces and are, therefore, not the best instruments for finishing the margins of a preparation. Proximal slices are most efficiently prepared with a diamond disk and subsequently smoothed with a steel "lightning" disk.

3. The cross-cut fissure bur can be used for finishing the gingival edge of a proximal box preparation for an amalgam restoration, provided that space exists for its proper manipulation without damage to an adjacent tooth or restoration. An end-cutting bur with side blades is preferable.

4. Before the application of margin-trimmers the enamel surface should be made as smooth as possible with rotary instruments.

5. Of all the instruments normally employed for finishing the enamel margins the margin-trimmer gave the smoothest possible finish, when used as indicated.

SUMMARY

The present investigation was undertaken because contradictory opinions exist regarding the use of instruments for finishing the enamel walls.

A comparison is made between the effects on the enamel walls of various instruments used in standard operative procedures. This comparison is made only between those instruments which are primarily designed for the same operation during a cavity preparation.

The effect of the instruments is recorded and discussed under two headings, namely, the enamel edge and the enamel surface.

A photomicrographic method employing back lighting is described for the examination and recording of enamel edges.

The mechanism responsible for the production of various types of edges and surfaces is discussed in detail.

The requirements of an ideal cavity margin and the instruments necessary for obtaining it are discussed, special attention being paid to the proximal gingival floor.

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ORTHODONTIC TREATMENT AND THE PERIODONTAL TISSUES*

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ONE would expect the orthodontist to be an optimist by nature, kept young in mind by his youthful patients. One would expect to see the periodontologist depressed and pessimistic by virtue of the scenes of destruction which face him daily. However, this is not the case; the periodontologist remains optimistic, whereas the orthodontist becomes more doubtful every day.

In many of the papers read before this and other periodontal societies, orthodontists have assumed that they can help immensely in the prevention of periodontal disease. However, Ballard (1953) in a paper before this Society showed the limitations imposed by the inherited facial form. He described morphological features, both skeletal and soft tissue, which combined to position the teeth in the dental arches. It is this understanding of the inter-relationship of the form of the facial skeleton, the shape, size, and function of the lips and tongue, and the shape or size of the dental arches which has changed our orthodontic thought in the last ten years.

The main theme of this paper is to discuss some of the many controversial points that were raised in a symposium given before the European Orthodontic Society in Eastbourne, in 1954, by Dr. Hellgren, Mr. Emslie, and Mr. Hovell. It is unfortunate that these papers were not more widely published, because they contained much interesting and controversial material. The subject matter can be dealt with in two parts:—

1. Orthodontic measures which are supposed to assist in the prevention or treatment of periodontal disease and the rationale behind their use.

2. Practical measures to ensure that from the point of view of periodontal health the occlusion is not adversely affected.

ORTHODONTIC MEASURES WHICH ARE SUPPOSED TO ASSIST IN THE PREVENTION OR TREATMENT OF PERIODONTAL DISEASE

1. Orthodontic treatment can relieve gross crowding and thus enhance the natural self-cleansing of certain areas and facilitate "artificial cleaning".

When Rix (1946) cited atypical swallowing as a causative factor in malocclusion, he envisaged the teeth erupting into an environment which did not foster good centrifugal development of the arches. He made the point that children with the "teeth apart swallow" were often clumsy eaters and gulped their food. Thus their teeth were deprived of the natural cleansing action of the tongue and lips. Elimination of the crowding itself will not eliminate abnormal oromuscular activity. Hellgren (1954) quoted Herulf (1951) and Forsberg (1951) who pointed out that the association between periodontal disease and crowding was not very strong when analysed statistically, but in a later paper Hellgren (1956) produced evidence of a more significant correlation.

2. In some instances the orthodontist can correct an incisor overjet which may be a primary cause of lack of lip seal. Ballard has coined the phrase "incompetent lip posture" and pointed out that the teeth may not be the primary cause of separation of the lips at rest. The lips may be deficient in length or flaccid and fail to effect a seal even when any existing overjet is reduced. Such patients may effect a lip seal by habitual contraction of the lips, but this does not prevent the seal from failing when the patient is relaxed in sleep.

3. Deep overbites are very difficult to treat as the soft tissues dictate the axial inclination of teeth. In the absence of any direct trauma to the soft tissues, either palatally or labially, such deep overbites have been shown by

* Paper delivered at the meeting of the British Society of Periodontology held on Jan. 12, 1959.

Emslie (1952) and others to be much less conducive to periodontal disease than a reduced overbite or a frank open bite. Rix (1953) and Ballard (1953) describe this type of deep overbite as associated with lack of forward tongue-thrust. An excessive circumoral contraction and tightness of the lips may also be present, even at rest (*Fig.* 1). The difference in depth of overbite between a case in which there is no trauma to the soft tissues and one where this is present may be due merely to a lack of buttressing of the incisors, particularly the lower, by an intact arch. This could be caused by premature loss of deciduous or permanent teeth (*Fig.* 2).

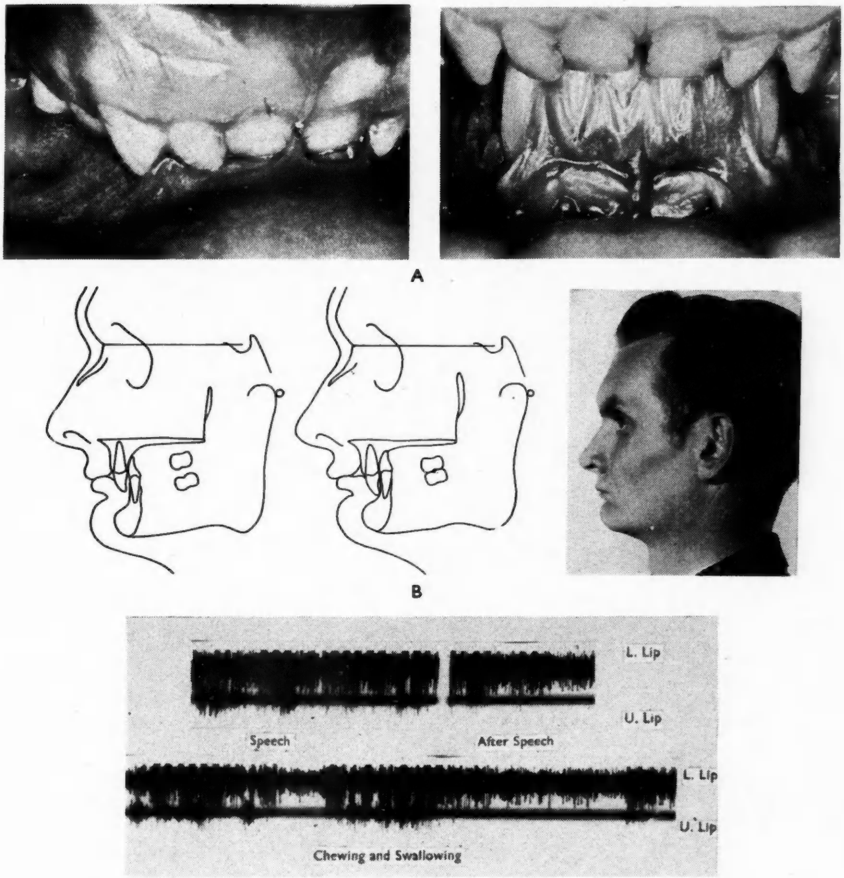

Fig. 1.—A, Deep overbite with trauma to the palatal and lingual gingivæ. B, Photograph and lateral skull of same patient showing rest position and marked incisor overbite in occlusal position. C, Electromyogram of lip musculature in various functions. Electrodes placed on upper and lower lips. Note excessive activity in lower lip during speech, chewing and swallowing, and spasm in lower lip after speech.

Where there is mild trauma, incisor grinding may be of assistance or the bite may have to be raised. Bite-raising appliances must be designed not merely to cover the posterior

teeth, which is only a temporary measure, but to embrace the incisal edges to prevent eruption of the incisors.

4. Cross and Yuktanandana (1957), and others, point out that orthodontic treatment of the adult can be of value in the treatment of

Fig. 2.—The effect of excessive component of lip force on overbite. Shaded area shows the normal relationship of incisors. Dotted line shows the effect of loss of teeth in lower arch which may allow overbite to become traumatic to the soft tissues.

established periodontal conditions, reducing areas of stagnation and enabling more thorough subgingival curettage to be carried out, even though these cases may require permanent periodontal splinting. Though undoubtedly of value, such treatment cannot be labelled as a preventive measure.

5. If one of the aims of orthodontics in relation to periodontal disease is to remove occlusal disharmonies, then one must believe that, to quote Hovell (1954), "occlusal trauma is a primary aetiological factor". This is a fundamental issue which has been debated many times before this Society.

I believe that there is no proof that occlusal trauma is the primary cause of a breakdown of the periodontal tissues in arches which have not been mutilated by extractions and have not been tampered with by the orthodontist. The inlocked upper central incisor with the opposing lower incisor pushed labially can always be quoted, as it may develop a labial gingival recession. However, this condition can be found where the lower incisor is out of occlusal contact (Emslie, 1952).

I believe we need to know a great deal more about the physiology of mastication and a great deal more about the innervation of the periodontal tissues. It is quite wrong to assume that everybody chews in the same pattern or to consider centric occlusion as a criterion of the functional working occlusion. We know from the work of Stewart (1927), Pfaffman (1939), Ness (1954), and others, that stretch receptors in *healthy periodontal tissues* should, theoretically, prevent teeth receiving abnormal stresses. There are some clinicians who believe that the direction of stress is important, and that the reflex protective mechanism does not operate if the teeth are malplaced.

We know that the teeth in opposing arches owe their position in the first instance to the relationship of the basal bones. As they erupt they are influenced by their soft-tissue environment and finally positioned by cuspal interdigitation. They might be expected to move away from a position in which they are likely to be overstressed. This would reduce the strain which might otherwise be borne by the fixation of individual teeth or the temporomandibular joint. Many clinicians who express the views that teeth in arches which are intact may receive occlusal trauma are prejudiced by seeing so many older patients where the supporting tissues of the teeth are already abnormal.

To return to the investigation of the physiology of mastication, one must refer to Jankelson, Hoffman, and Hendron (1953), Anderson (1955), and Pruzansky (1952), who point out that any investigation of artificial chewing movements has little practical application. Experiments to investigate chewing movements in an empty mouth have no sound physiological basis. On the evidence available, it is not necessary to produce a balanced occlusion in every case for the prevention of periodontal disease. Pruzansky (1952) has shown by electromyographic investigation that some people never use a true grinding action in mastication. They adopt a chopping action, but this does not mean that the

preparation of their food is any less thorough. In individuals who make virtually no lateral excursion, the periodontal tissues are reflexly inhibited from receiving abnormal stresses. Where the periodontal tissues are not in a healthy state, the protective reflex mechanisms are unable to operate normally, and this is where occlusal adjustment comes into its own.

The orthodontist may strive to correct abnormal axial inclinations of the incisors where the skeletal relationship and the soft-tissue environment allow. Hovell (1954) states, however, that in cases of bimaxillary protrusion there is an excessive labial component of force on the upper incisors. Certain ethnic groups have this type of incisor relationship, and their whole masticatory mechanism is geared to this. There is no evidence to show that as a direct result of this they have any increased incidence of periodontal disease. I would concede the point that patients with this type of incisor relationship may have a greater tendency to "bite out" their incisors when the periodontal tissues are ageing and they lose posterior teeth.

Hovell (1954) described damage to the periodontal tissues of the incisors due to a conflict between tongue and lip "posture" at rest, and tongue and lower lip activity in function. Such "jiggling", I believe, only occurs where there has been a primary breakdown in the periodontal tissues.

The orthodontist may be responsible for moving teeth into an environment where they may be in conflict between their muscular environment and occlusal forces.

I think it is essential for our better understanding of functional masticatory patterns that further work in the basic sciences should continue. This work should include the study of neuro-physiology of mastication using strain gauges, recording not only the maximum masticatory loads possible, but loads in different situations in the mouth with different types of diet and different types of occlusion, and over a wide age range (Anderson and Picton, 1958). This should be coupled with electromyographic studies of the masticatory musculature. Greenfield and Wyke (1956) have studied empty mouth movements of the mandible and are now studying functional movements.

PRACTICAL CONSIDERATION IN ORTHODONTIC TREATMENT

Orthodontic treatment is largely concerned with æsthetics, and it is necessary to examine the possibility of producing what, from the point of view of periodontal health, may be an unsatisfactory occlusion.

There is considerable controversy over the age at which orthodontic treatment should be begun and I am in general agreement with those who feel treatment should not begin too early, certainly not in the complete deciduous dentition.

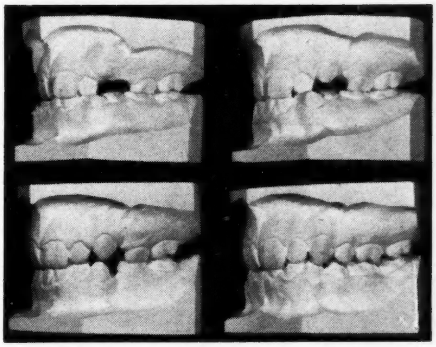

Fig. 3.—Case showing extraction of four first premolars with minimum appliance therapy allowing alinement of anterior teeth.

There are, however, a number of interceptive procedures which can be adopted at the time the incisors are erupting, thus eliminating such local disturbances as the inlocked central incisor. Hovell (1954) has decried the wholesale use of serial extractions in the treatment of incisor crowding, and has quite rightly pointed out that there must in many cases be a controlled movement of the incisors, as there is a danger of losing the temporary space created by the loss of the deciduous canines by forward drift of the posterior teeth. This forward drift may be accompanied by tilting and a disturbance of the contact point level. However, in selected cases incisor

alinement can be effected by this method with a minimum of appliance therapy (*Fig.* 3).

In view of the fact that the first permanent molars are so frequently carious, much more thought should be given to the early extraction of these teeth in cases of crowding. In Class I cases the untoward effects of the extraction of

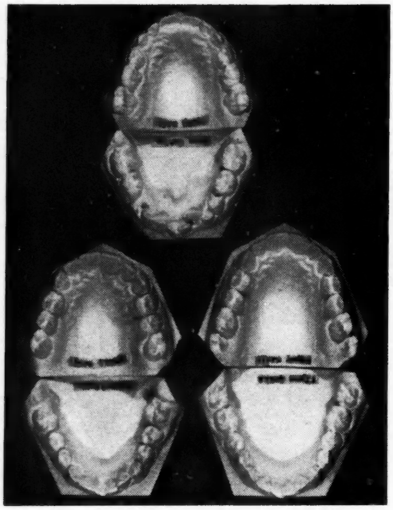

Fig. 4.—Case showing extraction of four first permanent molars at 8 years. Incisor alinement has greatly improved without appliances.

first permanent molars is found where the decision to extract them has been left too late. These untoward effects are mainly the tilting of the second molars, and drifting of the second premolars. The extraction of the first molars between 8½ and 10 years of age will allow improvement in alinement of teeth anterior to the site of extraction and the second molar erupts into good contact with the second premolar (*Fig.* 4). Rix (1953) points out that any slight tilting of the crown of the second molar tends to disappear with the normal further eruption. Occlusion must not be considered as a static condition in the child and continued eruption of the teeth and growth of the alveolus may be helpful factors. Abnormal rotation and distal tilting of the lower second premolar is due to abnormal crypt positioning and can be appreciated in early X rays. Such cases are unfavourable for the extraction of the first permanent molars. There is a definite need to evaluate a child's developing dentition at an early age, even if active treatment is not considered.

I do not share Hovell's concern over untoward tilting of all the cheek teeth which may result following extraction of the first premolars to relieve incisor crowding. There is often as much forward drift of the apices as of

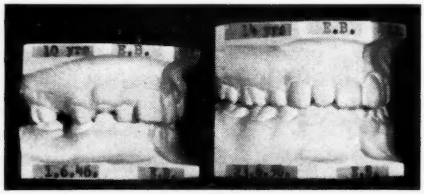

Fig. 5.—Class II, division 1 malocclusion treated by extraction of $\underline{4|4}$. In view of early loss in lower arch, $\overline{4|4}$ had to be extracted. An ideal result was obtained as there was no major discrepancy in the dental arches.

the crowns. I am concerned with regard to the extraction of the second premolars as the first permanent molar is not immediately buttressed by an adjacent tooth. In these cases there is a chance of untoward tilting of first permanent molars, producing a food trap.

The extraction of maxillary first premolars in Class II, division 1 cases frequently produces a very satisfactory result (*Fig.* 5). Sometimes, however, the maxillary cheek teeth may have a slight forward inclination which tends to correct itself by the time the child reaches the late teens. In Class II cases with some degree of anteroposterior crowding in the upper arch, Ballard (1954) favours the extraction of $\underline{7|7}$, maintaining that this interferes less with the contact points of the anterior teeth.

When all the first permanent molars are very carious, in a Class II, division 1 case, and have to be extracted early, the monobloc appliance can be employed to produce intermaxillary traction and impart a distal thrust on the upper arch. This appliance has fallen into some disrepute because it is not very

positive in its actions. The technique, although appearing to be disarmingly simple, is, in fact, quite complicated. With proper case assessment (choosing only cases which are suitable for intermaxillary traction), satisfactory results can be produced without any fixation of the appliance to the teeth and with

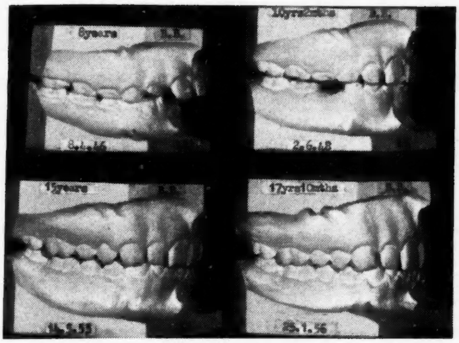

Fig. 6.—Class II, division 1 malocclusion treated with the "monobloc". Note large arches; no necessity for extractions.

only part-time wear (*Fig.* 6). Intermaxillary traction can also be produced using adequately clasped upper and lower plates. Well-constructed removable appliances should not damage the gingival tissues, particularly since the advent of the Adams clasp, which gives adequate stability without using subgingival spurs of the Visick type of clasp. *Fig.* 7 shows where a removable appliance has been used to treat a Class II, division 1 malocclusion. There are no residual spaces or poor contacts following extraction of $\overline{6|6}$.

Class III malocclusions have always been a bogy to the orthodontist but considerable improvement can be obtained where there is only a mild discrepancy in the dental base relationship. It is in the treatment of Class III cases with a major discrepancy in the dental base relationship that the orthodontist may have to proclinate the upper incisors excessively and even retroclinate the lower incisors to establish a slight incisor overbite. Where occlusal forces maintain this incisor position, the soft tissues of the lips and tongue may attempt to move the teeth in the opposite direction. It is in such cases that occlusal trauma could be a predisposing factor to early periodontal troubles.

There is another major problem which I would like finally to bring to your notice. So often the orthodontist is faced with lower

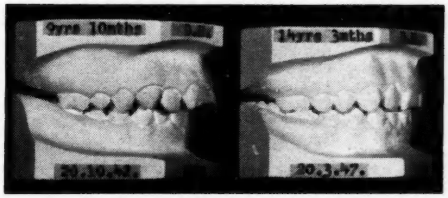

Fig. 7.—Class II, division 1 malocclusion treated by extraction of $\underline{6|6}$ after the eruption of $\underline{7|7}$ and distal movement of $\underline{543|345}$ using removable appliances, followed by retraction of $\underline{21|12}$.

incisor crowding in Class I and II cases with deep overbite. May it not be better to leave incisor crowding, unless it is very severe, in a position where these teeth can be readily cleaned rather than to break contact points in the cheek tooth segment by extractions?

Lower incisor crowding can sometimes be avoided if no attempt is made to open up space for premolars. The extraction of lower second molars may prevent further deterioration of incisor alinement. The extraction of a lower incisor merely to relieve crowding without any appliance control almost invariably results in the remaining incisors becoming crowded.

Lastly, I condemn the practice of producing an orthodontic result which requires the wearing of a permanent retainer. Although appliances worn for a short time do no permanent harm to the gingival tissues, full-time wear over a long period is harmful. This does not refer to the maintenance of an expanded arch with cleft palate where it is essential, or the use of periodontal splints following late orthodontic treatment in a case already presenting periodontal disease.

SUMMARY

The part that orthodontists can play in the prevention of periodontal disease is small and

confined to simple procedures. In improving the æsthetics of a dentition, the orthodontist must not produce an occlusion which is more likely to foster periodontal disease. Further research is required into the reflex control of masticatory function before too many dogmatic statements are made concerning traumatic occlusion as a primary aetiological factor. Both the orthodontist and the periodontologist are faced with a number of inherited factors largely beyond their control.

Acknowledgements.—My thanks are due to Mr. R. E. Rix, Mr. K. E. Pringle, and Mr. A. C. Campbell for permission to show cases under their care; to Miss Whiteley, of the Dental Photographic Department, for the preparation of slides and photographs; to Mr. Colwell for the preparation of models; and to Mrs. Rawlins for secretarial assistance.

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ABSTRACTS FROM OTHER JOURNALS

Effects of the Administration of Steroid Hormones on the Gingival Tissues

Two groups of patients suffering similar diseases were studied. The first group of 100 were receiving significant amounts of ACTH or one of the adreno-corticoid hormones, while the second group of 101 was receiving no hormone therapy.

It was found that the extent of the gingival inflammation and periodontal destruction depended more on the age and oral hygiene of the individual than on the hormone therapy. Steroid therapy did not produce a gingival reaction.—KROHN, S. (1958), *J. Periodont.*, **29**, 300.

Comparative Effects of Local and Systemic Antibiotic Therapy in the Prevention of Postextraction Bacteriæmia

A random selection of 357 patients was made from patients requiring at least two extractions. Care was taken to ensure that antibiotics had not been administered for at least 10 days prior to the investigation. A control group and 8 experimental groups were formed. No antibiotics were given to the control group. Various antibiotics were applied locally and/or systemically in the experimental groups.

Saliva samples were taken before and after the administration of antibiotics and blood-samples were taken before, immediately after, and 10 minutes after the extractions.

Results.—The bacteria found in the blood-stream were normal oral inhabitants for the mouths concerned. In the control group the incidence of bacteriæmia was reduced by minimizing the trauma sustained at extraction. The incidence was also reduced with the use of antibiotics in troches. A single intramuscular injection of an antibiotic was only slightly effective, and the combination of local and systemic administration gave the best results. The most effective combination of drugs was a troche containing penicillin, bacitracin, sulfa-diazine, and benzocaine half an hour before extractions, together with an intramuscular injection of penicillin streptomycin mixture one hour before operation.—BENDER, I. B., PRESSMAN, R. S., TASHMAN, SYLVIA G., *J. Amer. dent. Ass.*, **57**, 54.

AN IMPRESSION TECHNIQUE FOR GOLD PINLAY RESTORATIONS

By HENRY ALLRED, M.D.S. (Manc.)
University of Manchester

INTRODUCTION

WAX patterns required for the production of gold inlays may be obtained either by the direct method—the adaptation and contouring of wax to the cavity in the mouth, or by the indirect technique, involving the construction of a die for the extra-oral modelling of the wax.

A gold pinlay consists essentially of a thin lingual veneer and one or more pins. The veneer is difficult and time-consuming to wax up in the mouth and is more readily produced by an indirect technique. On the other hand, unless preformed platinum pins are used, the pins are difficult to reproduce by the indirect method, and usually require direct waxing in the mouth.

In consequence, it is common practice to produce a wax pattern from a die which has not recorded the pin-holes and adapt it to the preparation in the mouth to obtain the pins. This, however, endangers the wax pattern and involves an extra visit for the patient.

The technique to be described has been found convenient for the accurate reproduction of tapered pin-holes, using elastomeric impression materials.

METHOD

The Preparation of the Pin-hole.—To facilitate the accurate sinking of the pin-hole, a ledge is first cut into the sloping lingual surface of the preparation with a No. 4 inverted-cone bur (*Fig.* 1). This bites into the dentine more easily than a fissure bur, but care must be taken to remove the undercuts which are produced.

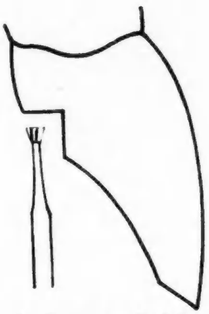

Fig. 1.—Preparing the ledge with a No. 4 inverted-cone bur.

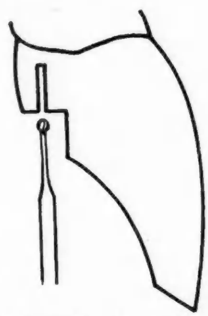

Fig. 2.—Sinking the pin-hole with a No. 1 rose-head bur.

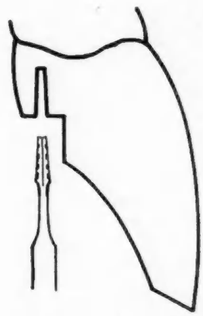

Fig. 3.—Shaping the pin-hole with a No. 700 tapered fissure bur.

This ledge forms a flat surface at right angles to the long axis of the required pin-hole, for easy penetration when sinking the pin-hole to the correct depth with a No. 1 round bur (*Fig.* 2). The hole is now smoothed and shaped by a No. 700 tapered fissure bur (*Fig.* 3).

Impression Technique.—One old No. 700 tapered fissure bur is taken for each pin-hole, and using a carborundum disk the shank is divided where it begins to taper, the bur head and tapered portion of the shank being utilized in the technique. The short bur, having a more rapid taper of the shank, is more easily retained in the impression material than the long bur.

An elastomeric impression is now taken in the following manner: In order to clearly expose the cavity margin, the gingival sulcus

adjacent to the preparation is carefully packed with cotton-wool, moistened in 10 per cent zinc chloride. With the burs in situ, a single layer of pink sheet wax is then adapted labially and lingually over the tooth in question, and also over half its neighbours. A composition

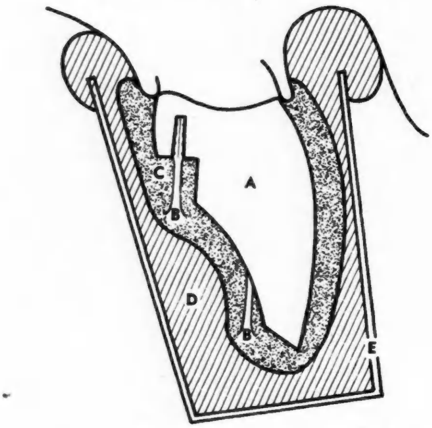

Fig. 4.—The impression in position in the mouth. A, Tooth; B, Bur-heads in the pin-holes; C, Wax or elastomer; D, Composition; E, Metal impression tray.

impression of the arch is now taken for use as a special tray, the wax preventing displacement of the burs and allowing for the optimum $\frac{1}{8}$ in. thickness of impression material. The teeth at either end of the arch provide stops (*Fig.* 4).

After the removal of the composition impression from the mouth, the wax and cotton-wool are discarded and the impression and bur-heads are dried and coated with adhesive. The impression material is now mixed and each bur-head coated and inserted into the pin-hole; it is then injected around the preparation and placed in the composition impression which is seated in the mouth (*Fig.* 4) (Kinghorn and Allan, 1957).

Fig. 5.—A composition based elastomeric impression for the construction of a fixed bridge to replace 2|. The abutments are prepared for a post-crown 1| and a pinlay 3|.

An elastomeric impression is thus obtained which faithfully reproduces both the cavity margin and the pins.

The same technique may also be adapted for composition impressions in copper-bands.

A preformed metal post with a collar may be used in a similar manner when an elastomeric impression of a post-crown preparation is required.

REFERENCE

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Early Carcinoma of the Gingiva simulating Gingival Hyperplasia

A case report of a white female patient, aged 28 years, who presented with a lesion which appeared as a curtain of gingival tissue on the labial aspect of three maxillary incisor teeth, under which a probe could be inserted for about 6 mm. Biopsy examination of this revealed an epidermoid carcinoma.

There was also an enlarged submandibular lymph-node: biopsy revealed a metastasis.

Treatment consisted of a block exision of the premaxilla and a cleft radical dissection of the lymph-nodes in the neck. No further metastases were found on histological examination of those nodes.

Recovery was said to be uneventful, but the period of post-operative observation must have been short, as the date of the initial presentation was only March, 1957.—Schreiber, H. R., and Waldron, C. A. (1958), *J. Periodont.*, **29**, 196.

SPRING-WRAPPING PLIERS

By **J. H. MARTIN**, L.D.S. R.C.S.
School of Dental Surgery, University of Sheffield

THESE have been designed primarily for finishing off apron springs (Rix, 1938), X and V springs, and less well-known springs used in fixed appliances, which involve wrapping a fine spring wire on to a support wire (labial or lingual bow) which is more or less at right angles to it (*Fig.* 1).

They are a development of the Smythe pliers of the 1930's, and permit a more exact location of the spring wire upon the bow wire. An important feature of these new pliers is that the working face of one jaw is only one-third of the width of the opposing jaw so that it does not impede the upward and over sweep of the spring wire as it is wrapped round the bow. The spring wire lies in a longitudinal groove and, on closing the pliers, is held firmly under the bow wire which is located in the transverse groove (*Fig.* 2).

The first stage in construction from box-jointed blanks is shown (*Fig.* 3) and Gardiner (1949) gives the method for hardening and tempering. All the grooves were cut with a straight fissure bur, size ½, after first making a slight cut with a file.

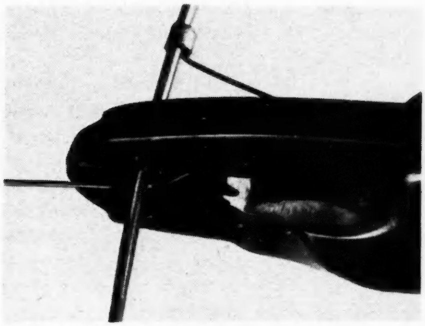

Fig. 1.—Demonstrating use in constructing a V spring.

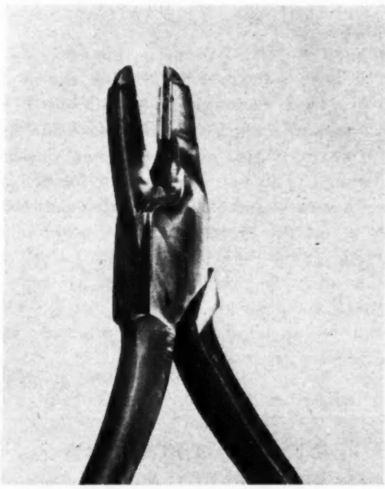

Fig. 2.—To show longitudinal and transverse grooves.

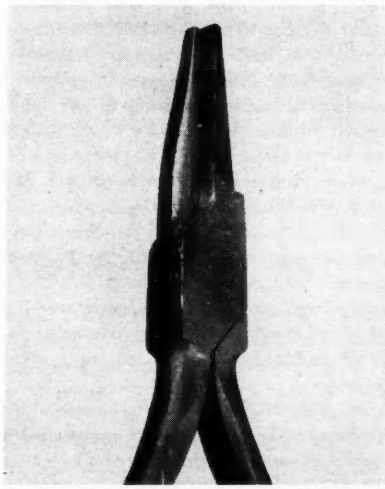

Fig. 3.—Stage in the construction of the pliers.

Gross reduction of the blanks was carried out on a dental lathe wheel, and they were finished with files and emery disks.

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BOOK REVIEW

ORTHODONTICS IN GENERAL DENTAL PRACTICE. By G. C. Dickson, B.Ch.D., F.D.S., D.Orth.R.C.S. Orthodontic Consultant to the Portsmouth Hospital Group. $8\frac{1}{2} \times 5\frac{3}{8}$ in. Pp. 337+vii, with 361 illustrations. 1959. London: Pitman Medical Publishing Co. Ltd. 75s.

This new book on orthodontics, designed primarily for the general dental practitioner, will go far towards filling a long-felt deficiency in the British literature on this subject. Written in a concise manner, it embraces most of the information required by a practitioner who does not specialize in orthodontics. Although at first it may appear to be rather expensive, this is justified by the generous array of first-class illustrations, of which there are 361.

The subject matter is arranged, quite logically, in the order of clinical procedure in treating a case. This, however, has the disadvantage of necessitating in places cross references from earlier to later chapters. The author wisely confines himself to the simplest and most explicit terminology which is defined in the first chapter. The next two chapters are competent descriptions of the growth of the skull and development of the dentition. The latter is perhaps a little briefer than its importance justifies. In a chapter devoted to cephalometry the author describes his own simplified craniostat. A minimum number of fixed points used in cephalometric analysis are defined, and a simple technique of analysis is described.

After a short chapter dealing with the oral musculature the aetiology of malocclusion is discussed at some length. There follows a useful chapter describing treatment for specific types of case. It is in this chapter that a number of appliances are mentioned before they have been fully described. A detailed description of impression techniques is followed by an account of band making and the preparation of extra-oral traction. The chapter dealing with the techniques of appliance construction is based on those described by Adams. Before showing a selection of removable appliances to cover most requirements, the parts that make up one of these are described. The crib usually attributed to Crozat might have been a better choice than the one the author calls a Crozat crib. The chapters describing functional appliances are very competently executed; these include some unusual lower inclined planes. Fixed appliances receive more than adequate attention, the twin wire arch being described in some detail. On the other hand, the role of therapeutic extractions is dismissed in seven pages.

After a final brief chapter on preventive treatment, the book is completed with a useful guide to gauges of wire for orthodontic appliances. These may be found by some to be heavier than those they are accustomed to using. At the end of each chapter there is a short bibliography on the subject of the chapter.

It may be felt by some that the author should have mentioned the need for clinical and practical instruction before some of the techniques and appliances described are used. Particularly is this so of some of the fixed appliances. This volume has gone farther than any other to dispel the reviewer's belief that a book is not the best medium for teaching the practical part of orthodontics. Both the author and the publishers are to be congratulated upon an excellent work, which should be at hand in every practice where children are treated.

B. C. L.

DENTAL RADIOGRAPHY

A two-day course in dental radiography has been arranged for dental nurses and assistants, to take place on Thursday and Friday, May 7 and 8, 1959, at the Ilford Limited Department of Radiography and Medical Photography, Tavistock House North, Tavistock Square, London, W.C.1.

No fee is charged for this course. Application forms will be sent on request.

4TH GIBBS TRAVELLING SCHOLARSHIP AWARDS

The 4th Gibbs Travelling Scholarship, comprising three scholarships to the value of £150 each to assist members of the dental profession to visit the 100th Anniversary Meeting of the American Dental Association and the 49th Annual Meeting of the F.D.I. in New York, has now been awarded.

It was unanimously decided by a Scholarship Sub-Committee set up by the British Society of Periodontology to make awards to Mrs. L. J. M. Knox, Dr. G. A. Lammie, and Mr. J. Rodgers, D.F.M.

They will report as a team on developments in preventive dentistry within the programme of the meeting, and also on the impact of dental health education on the public in America.

They will present their findings at a meeting of the British Society of Periodontology during the next winter session.

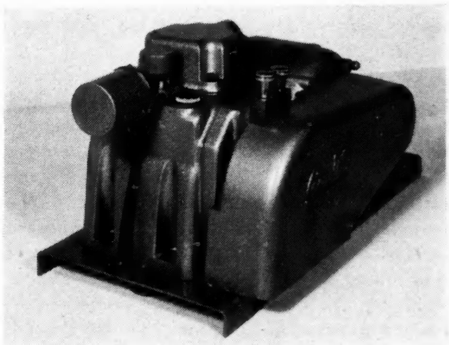
ANGLO-CONTINENTAL DENTAL SOCIETY

The title of the Fourth Hans Turkheim Memorial Lecture is "Non-carious Loss of Tooth Substance". Professor P. O. Pedersen will deliver this lecture at the Spring Meeting on May 9.

NEW MATERIALS AND APPLIANCES

A New Vacuum Pump

The photograph shows the "Genevac" single stage high vacuum rotary piston pump which is in 2, 4, 8, and 12 c.ft./min. capacity with an



ultimate vacuum of less than 0·005 mm. Hg. There is also a double stage model giving 0·0002 mm. Hg.

These are two of a range of pumps of new design produced by Genevac Ltd., of Radcliffe, Lancs.

ABSTRACTS FROM OTHER JOURNALS

The Use of Stainless Steel Pins to Strengthen Amalgam Restorations

Use is made of fine-gauged stainless steel pins inserted securely into the dentine. They are useful for large Class II cavities with wide bucco-lingual extensions and minimum retention form. Two or three pins are inserted 2–3 mm. into the dentine of the gingival floor, into holes drilled with a bur of the same gauge, and secured with cement.

Metallurgically, austenitic stainless steel, in contrast to gold and gold alloys, will not undergo any alloying reaction with amalgams owing to the presence of an impervious oxide film on the surface of the stainless steel. A potential difference of 0·53–0·65 volt may exist between the stainless steel and amalgam in the presence of saliva. Thus a tendency for the amalgam to corrode (stainless steel is positive relative to amalgam) is obviated by ensuring that the pins penetrate the bulk of the amalgam but are not exposed on the surface of the restoration.—Wright, D. W. (1958), *Aust. dent. J.*, **3**, 369.

Experimental Occlusal Trauma imitating Cuspal Interferences

An experiment was designed to ascertain the effect of a "jiggling" type of trauma on the periodontal tissues.

In 6 *Rhesus macacus* monkeys, about 4 years of age, a crown was fitted to the right maxillary second molar. This crown was contoured occlusally so that a buccal thrust was produced when the teeth were occluded, while a lingual tension was produced when the mouth was open by a palatal hook attached to a palatal arch wire, fixed to bands on the second molars. The palatal spring was activated to exert 2 oz. of tension.

The monkeys were sacrificed: 2 after 3 days, and 1 each at 14 days, 21 days, 3 months, and 6 months. It was found that when the experimental period was up to 3 weeks there were changes identical with those previously described in traumatic occlusal experiments. The traumatic changes had completely disappeared in the 2 cases where the experimental period was longer and the only change from normal was a broader periodontal space and a lengthened periodontal ligament. These changes clinically caused an increased mobility, but no gingivitis or periodontitis was observed.—Wentz, F. M., Jarabak, J., and Orban, B. (1958), *J. Periodont.*, **29**, 117.

The Effects of Stress on the Periodontium of the Syrian Hamster

Twenty-four Syrian hamsters were divided into a control group of 6 and the remaining 18 animals were subjected to different types of stress. For 2 weeks they were placed in cages in a deep-freezer at zero degrees Fahrenheit for 30 minutes daily. For the succeeding 2 weeks they were placed in a water-bath for 5 minutes at 48° F., and for the final 2 weeks 0·4 c.c. of 10 per cent formalin were injected subcutaneously in each, in an area which they could not scratch.

Only 7 of the experimental animals survived the 6 weeks. One of the control animals died.

It was found that the principal fibres of the periodontal membrane appeared to be coarser in the animals which had been subjected to stress and for some reason the fibroblasts appeared to be more mature, although there was less regularity in the arrangement of the fibres. The new bone-formation was irregular and the bone described as heteromorphic with rounding of the osteoblasts, which had pyknotic nuclei arranged irregularly.

Contrary to findings of others, there was no apparent decrease in the number of osteoblasts, no apparent increase in the number of osteoclasts, no significant decrease in the number of collagen fibres, and no apparent decrease in the number of cementoblasts.

Bone resorption was observed on the distal alveolar wall and apposition on the mesial wall suggesting distal drift rather than mesial drift.—Fedi, P. F. (1958), *J. Periodont.*, **29**, 292.

Proportion of Dental Amalgam

The accuracy of 12 different makes of alloy and mercury dispensers was checked by weighing the amounts dispensed on an analytical balance. The mean and standard deviations for the weights dispensed were calculated and the variations in the resulting mercury/alloy ratios were determined.

The results showed a considerable difference in the degree of accuracy exhibited by different makes of dispenser. Those of the balance type (i.e., dispensation by weight) showed less accuracy than those dispensing volumetrically. Many dispensers were not set accurately by the manufacturers and required adjustment.

The greatest accuracy was obtained by the use of pre-weighed segrines and a reliable mercury dispenser. However, the volumetric alloy and mercury dispensers supplied by Baker and the twin volumetric mercury/alloy dispensers supplied by S. S. White gave good results, as also did the S. S. White mercury dispenser both with segrines and with the metal scoop for use with the loose alloy powder.

Amalgam test specimens were prepared using different mercury alloy ratios and the crushing strengths of these specimens were plotted as a function of these ratios. It was shown that accuracy in proportioning was necessary for strength in the set amalgam.—Ryge, Gunnar, Fairhurst, C. W., and Oberbreckling, R. E. (1958), *J. Amer. dent. Ass.*, **57**, 496.

HOW MUCH CAN WE HOPE TO REDUCE THE INCIDENCE OF MALOCCLUSION THROUGH PROPHYLACTIC MEASURES?

By Professor A. LUNDSTRÖM, *Stockholm*

The efforts of every medical speciality must be to make itself out of date through such effective prophylaxis that the illnesses or disturbances concerned disappear or, at any rate, get their incidence reduced as much as possible. The aim of this paper is to discuss to what extent this might be possible in the orthodontic speciality. I am, of course, fully aware of the fact that the title of this presentation might seem a bit presumptuous, but I believe, nevertheless, that the importance of the question might justify its discussion, even at the present stage of our knowledge.

Statements of the incidence of malocclusion depend first of all upon how the limit is defined between the normal and the abnormal. In presenting figures of incidence it is desirable to divide malocclusion not only into different types but also into different degrees, depending on the extent of the deviation from the norm.

I would digress too far if I should try here to analyse in any detail the incidence of all the different types and degrees of malocclusion. I will confine myself to mentioning some few investigations which have a bearing on the incidence of crowding, post- and prenormal occlusion, open bite and closed bite. My purpose is just to illustrate what all of us know so well, namely how common such deviations are from that ideal we used to look upon as the only satisfactory goal of our efforts.

We are interested in the first place in the distribution of malocclusion at a stage when the development of the dentition is more or less completed. If we determine the incidence during the mixed dentition period we would, for example, have to allow for the possibility that some of the local crowding registered might change into more or less normal conditions when the premolars erupt. Some cases also get more aggravated with age, as, for instance, the so-called true prenormal cases.

The distribution of crowding and spacing for the teeth in 139 schoolboys from Stockholm of about 13 years of age is shown in

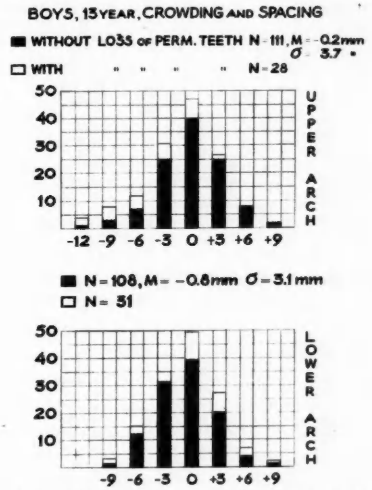


Fig. 1.—Distribution of crowding and spacing (arch-perimeter from M_1 to M_1 minus sum of corresponding tooth-breadths) in 139 boys, about 13 years of age. In cases with loss of permanent teeth an estimated figure is given of the probable space-difference, had the loss not occurred. In the upper jaw, figures obtained have been reduced by 1 mm., as cases without crowding or spacing showed, on an average, a space-difference of about +1 mm. in this jaw.

Fig. 1. It is obvious that the distribution is more or less similar in the upper and lower jaws. The cases with even dental arches are most frequent, while lack of space seems to be only slightly more common than surplus of space at this age. Some investigations indicate that crowding increases during the

The Twelfth Northcroft Memorial Lecture, given at the meeting held on November 10, 1958.

later development so that the distribution would be somewhat different in the adult from that at 13 years of age.

In *Fig.* 2 the variability of the overjet and overbite is demonstrated. The diagrams are based upon the investigation of Seipel (1946).

Twin-investigations give us an overall picture of the importance of non-genetic factors as compared with that of genetic factors. The type of information such investigations provide is illustrated in *Figs.* 3 and 4, from which it appears that non-genetic factors seem to have less influence than the genetic in causing deviations from the mean. This is in agreement with the findings related to other anthropological characteristics.

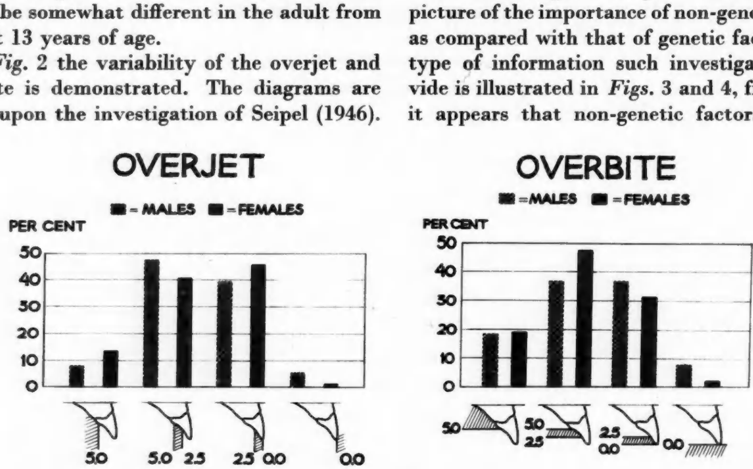


Fig. 2.—Distribution of different degrees of overjet and overbite (38 males and 99 females) in the adult (cases without extractions), according to Seipel (1946).

One can, perhaps, say that an overjet within the limits of 0–5 mm. can be looked upon as almost normal, and in that case about 10 out of 100 Swedes have an excessive overjet and less than 5 out of 100 have a negative overjet with mandibular incisors in front of maxillary incisors.

Corresponding figures for the vertical overbite are 20 per cent with excessive and about 5 per cent with a negative overbite, that is with a space between upper and lower incisal edges, measured at right angles to the occlusal plane.

This may suffice to illustrate the well-known fact that the variability of the human dentition is considerable and comparatively often abnormal to such a degree as to cause the individual troubles of different kinds. I will now turn to the question:—

TO WHAT EXTENT IS THE TOTAL VARIABILITY DUE TO NON-GENETIC FACTORS?

In an attempt to answer this question we have two types of evidence to consider, that is twin-investigations on one hand and special investigations into the role of separate environmental factors on the other.

But before we can state that our prophylactic possibilities are quite limited, we must know to what extent the genetic variability is due to the direct effects of the genes and to what extent to indirect effects that may be influenced by prophylactic measures. Examples of such indirect influences are inherited tendencies to finger-sucking and to a high susceptibility to dental caries, giving an increased incidence of early loss of deciduous teeth. It is impossible to calculate the relative importance of direct and indirect genetic influences through comparison of mono- and dizygotic twin-pairs. Generally speaking, indirect genetic factors can be of some importance in the genetic variability under two conditions: (1) In connexion with such environmental factors that are potent in causing malocclusion; and (2) If monozygotic co-twins are more equally exposed to these factors than dizygotic co-twins.

In order to get any further it is therefore necessary to discuss these two questions in relation to those environmental factors which

can be believed to have some definite part in the aetiology of malocclusion.

We must consequently first decide which environmental factors must be considered. The following list would seem to include all those factors that have been discussed in the literature: (1) Maternal complaints during pregnancy; (2) Birth trauma; (3) Bottle feeding; (4) Deficiency of accessory factors in the diet; (5) Morbid conditions in the ear, nose, and throat regions, mouth-breathing; (6) Illness of other kind than that due to (4) or (5); (7) Food softness and lack of exercise of the jaws; (8) Finger-sucking and other habits; (9) Early loss of deciduous teeth; (10) Loss of permanent teeth; (11) Trauma and other accidents.

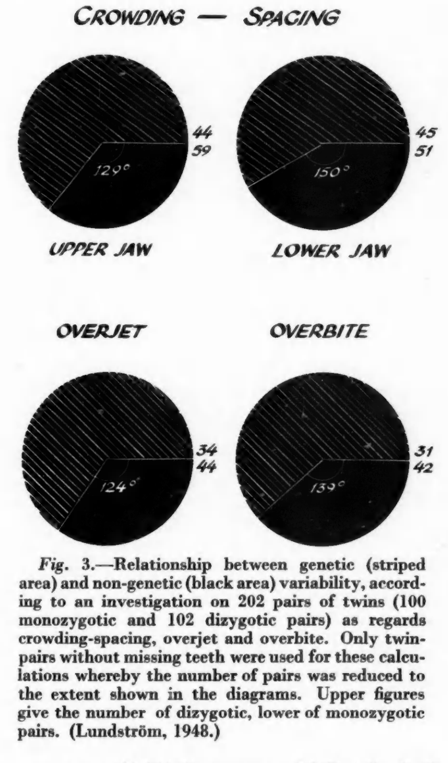


Fig. 3.—Relationship between genetic (striped area) and non-genetic (black area) variability, according to an investigation on 202 pairs of twins (100 monozygotic and 102 dizygotic pairs) as regards crowding-spacing, overjet and overbite. Only twin-pairs without missing teeth were used for these calculations whereby the number of pairs was reduced to the extent shown in the diagrams. Upper figures give the number of dizygotic, lower of monozygotic pairs. (Lundström, 1948.)

I would now like to try to evaluate each of these groups briefly. Trying to cover so much material in one single paper will necessitate generalization to an extent that may be misleading, especially where the literature is controversial. It is therefore not improbable that some of you here will disagree with my interpretation of our knowledge on these problems. If that is the case I will be only too happy if you would raise such questions in the discussion.

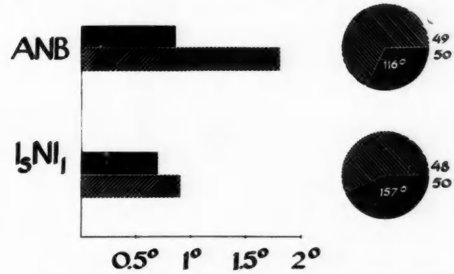


Fig. 4.—Non-genetic (black bar and area) and genetic (striped bar and area) variability as regards the angles subspinale–nasion–supramentale (ANB) and incision superior–nasion–incision inferior (I_sNI_i) according to an investigation on 100 pairs of twins (50 monozygotic and 50 dizygotic same-sexed pairs). (Lundström, 1955.)

1. Maternal Complaints during Pregnancy.—There seems to be no clear-cut evidence as to any association between maternal complaints during pregnancy and developmental disturbances resulting in malocclusion of the child.

It has been suggested that a virus disease of the mother may have a bearing on the facial development of the child, as it has been proved that rubella in the first 3 months of pregnancy can cause certain other anomalies such as congenital heart-disease, hearing defects, congenital cataract, and so on. A recent finding showing a significant difference between "rubella children" and controls as to the head circumference in relation to body-length adds interest to the question of the relationship between the health of the mother and malocclusion (Lundström, 1958).

So far there is no evidence, however, indicating that prophylactic measures in order to improve the condition of the mother during pregnancy would result in any decrease in the incidence of malocclusion.

2. Birth Trauma.—Special investigations (Hofbauer, 1943; Clinch, 1949) have shown that complications in connexion with delivery do not generally cause malocclusions. The finding by Dahlberg (1926) that the first-born of monozygotic twins seems to have a somewhat more dolichocephalic head and a somewhat higher face than the second-born may perhaps indicate that at least a long and difficult labour could have some influence also on the jaws. However, as far as can be seen from the evidence at hand, this factor is a minor one in the aetiology of malocclusion.

3. Bottle Feeding.—In some of the textbooks we are told that bottle feeding is very inferior to breast feeding, as the full growth of the lower jaw is said to require the functional stimulation of breast feeding. The investigation of Humphreys and Leighton (1950) seems to prove that this statement belongs to the type of speculation that through authoritative repetition acquires a false air of being a proven fact. As far as I can see, it is not very probable that the use of those specially devised bottles, which keep the lower jaw a little bit forward during the sucking, would lead to any decrease in the incidence of postnormal occlusion.

4. Deficiency of Accessory Factors in the Diet.—We have all of us seen those illustrations in the literature that show severe abnormalities of experimental animals in the growth of the jaws and face following the more or less complete lack of different vitamins in the food. In man the effect of rickets has been discussed especially, because extreme types of a saddle-shaped upper jaw and open bite often seem to be combined with severe hypoplasia of the enamel and a history of rickets. Investigations, such as the one by Friel (1922) just after World War I, show, however, that the effect of rickets is not so easily defined. A child may very well have had rickets and still get no malocclusion. Neither is there any general association between hypoplasia of the enamel and a saddle-shaped upper jaw or open bite.

It is possible that only very severe rickets or similar disease for many years without any treatment will produce the symptoms mentioned. Further research is certainly necessary before we can determine the role of rickets and other deficiency diseases in the causation of malocclusion. Much has, of course, already been done to ensure that our children get a fully satisfactory diet. On account of this it is doubtful if further steps in this direction will help to any extent in reducing the incidence of malocclusion.

5. Morbid Conditions in the Ear, Nose, and Throat Regions (Mouth-breathing).—In discussing ear, nose, and throat disease and its significance in our field, such an obvious and extremely rare condition as the so-called "Vogelgesicht" following early ankylosis of the mandibular joint can be passed over. The problem is what association there is between the so-called adenoid type of child with more or less complete mouth-breathing and special types of malocclusion, and how to interpret such an association. Systematic observations, such as the one by Humphreys and Leighton (1950), suggest that the association between mouth-breathing and the type of occlusion is weak. It is, furthermore, conceivable that any relationship between the two should be interpreted not as cause-and-effect but as a combined result of a third condition, e.g., a generally narrow type of face. There is an obvious need for further research into these questions before we can draw any definite conclusions.

6. Illness of Other Kind than due to Food Deficiency or Ear, Nose, and Throat Defects.—There seems to be no evidence indicating that ordinary diseases of children, such as exanthematous fevers, have any significance in the aetiology of malocclusion. Such diseases generally are so short in duration that it is rather improbable that any such association could exist.

One general disease, which in rare cases seems to interfere with the growth of the lower jaw, is rheumatic fever. In cases with a chronic rheumatic arthritis in the mandibular joint the child can show a similar arrest of the condylar growth, as when suppurating otitis media spreads to the joint.

Other disease of a more severe character might possibly have some influence on the development and growth of the jaws and thus be the cause of malocclusion. It must be stated, however, that our evidence of such causal relationships is very unsatisfactory. We cannot, at the present time, name any illnesses that, even in their severe forms, will give specific growth disturbances predisposing to certain, well-defined malocclusions. We lack conclusive evidence as to the true effect in this respect also of different hormone diseases. I am excluding congenital deformities such as cleft palate, dysostosis cleidocranialis or cranio-facialis, and so on, in this connexion, as such conditions can hardly be classified as diseases in the general meaning of the word.

7. Food Softness and Lack of Exercise of the Jaws.—The significance of mastication as a stimulus to jaw-growth has been studied experimentally through unilateral grindings, extractions and operations, and the degree of asymmetry has been used as evidence.

Such experiments are rather artificial. It is, therefore, difficult to draw any conclusions from them, which can be applied to the real problem. This can be formulated thus: Would a change from the moderate present-day mastication forces to a more intense chewing of harder food produce larger dental arches or better occlusion with, for instance, less postnormal

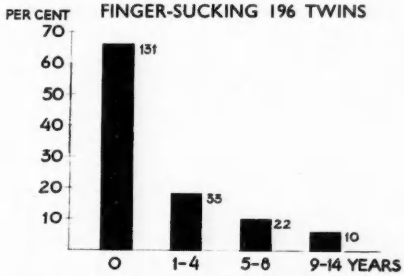


Fig. 5.—Numbers and percentages of twins without (O) and with finger-sucking up to different age-stages. One case still sucking at 13 years and two who could not tell when their finger-sucking stopped were not included.

occlusion than we have got to to-day? Watt's and Williams's (1951) experiment on growing rats with two groups of animals, fed on the same food except for consistency, can be applied to the problem, but the difference in hardness was so extreme that even this investigation cannot give us the evidence required to answer the question. Personally, I must admit that I would be astonished if further research could prove that the use of harder food would

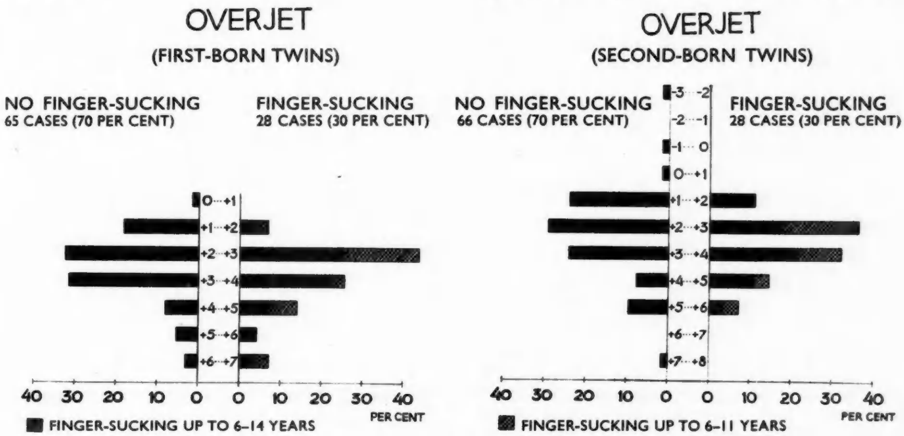


Fig. 6.—Distribution (in per cent) of the overjet in 131 twins who never sucked the fingers, and in 56 twins with a history of finger-sucking.

decrease the incidence of malocclusion to any extent worth mentioning.

8. Finger-sucking and Other Habits.—Every orthodontist knows that finger-sucking and other habits involving oral pressures can be the cause of more or less marked deformities of the arches, especially regarding the position of the front teeth. The effect of these habits depends most probably in the first place upon the intensity (force and duration per 24 hours).

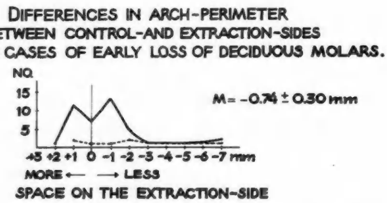


Fig. 7.—Distribution of 41 cases with early unilateral loss of deciduous molars as regards difference between control side and extraction side in length of arch-perimeter from contact-point between medial incisors to distal contact-point of first permanent molars. Dotted line shows cases for which the loss occurred before school-age (school starts in Sweden in the year when children are 7 years of age). (Linder-Aronson, 1958.)

An essential problem is this one: How often will finger-sucking result in a lasting malocclusion? In order to contribute to this question I have collected data on any finger-sucking among 196 twins and one set of triplets from their mothers. The results are given in *Figs.* 5 and 6 and in *Table I*.

Table I.—Overjet and Overbite (in mm.) in Twins without and with Finger-sucking and in Twins with Prolonged Finger-sucking

		First-born Twins		Second-born Twins	
		Overjet	*Overbite*	*Overjet*	*Overbite*
No finger-sucking	N	62	65	65	65
	$\bar{x} \pm \epsilon(\bar{x})$	$3·0 \pm 0·19$	$2·7 \pm 0·18$	$2·7 \pm 0·18$	$2·7 \pm 0·23$
	S	1·51	1·41	1·47	1·85
All finger-suckers	N	29	29	27	27
	$\bar{x} \pm \epsilon(\bar{x})$	$3·1 \pm 0·25$	$3·3 \pm 0·23$	$3·1 \pm 0·23$	$2·9 \pm 0·25$
	S	1·34	1·25	1·17	1·31
Finger-suckers up to 6–14 yr.	N	10	10	10	10
	$\bar{x} \pm \epsilon(\bar{x})$	$3·1 \pm 0·46$	$3·7 \pm 0·37$	$3·1 \pm 0·36$	$3·1 \pm 0·36$
	S	1·45	1·16	1·13	1·45

(N = number of cases, $\bar{x}$ = mean, $\epsilon(\bar{x})$ = standard error of mean, S = standard deviation)

It should be mentioned that in most of the cases with finger-sucking the habit had stopped some considerable time ahead of the investigation. From this point of view the cases were distributed in the following way:—

Finger-sucking up to	No. of Cases	Number of Years without Finger-sucking at Examination	
		Average	*Range*
1–5 years	42	9·9	4–15
6–14 ,,	24	5·8	0–11*

* 6 cases had stopped their sucking 0–3 years before the examination (1 of these still sucked, at the age of 13 years)

Some cases were not used for *Fig.* 7 and *Table I* for various reasons, mainly on account of orthodontic treatments. As this reduction of the material might have influenced the results, it is necessary to give an account of these cases:—

Out of 5 cases without finger-sucking not used in *Table I*, 4 (3 first-born and 1 second-born) had undergone simple treatments (biting on a spatula, grinding) in order to correct a tendency to lingual occlusion of upper incisors to lower. One had had a fracture of the upper central incisor-crowns and could not therefore be measured.

Out of 11 cases with finger-sucking not used, 8 had had orthodontic treatments. Two of these were of the same kind as mentioned above, 6 had undergone more complicated treatments, while 3 cases were excluded for non-orthodontic reasons.

The fact that 6 (in 4 pairs) out of 67 cases with finger-sucking had got definite orthodontic treatment while none of 132 cases without finger-sucking was reported to have been treated in the same way, may suggest some association between finger-sucking and obvious malocclusion. One must then first of all ask if the 6 cases mentioned were such that had an excessive overjet or overbite before treatment. The following data were obtainable for these cases:—

Twin-pair	Finger-sucking up to (Yr.)	Diagnosis	Age	Overjet	Overbite
			Before Treatment		
II 40 b	4	Ling. occl. B| and C	6	1–2*	0–0·5*
I 80 b	5	Bimax. crowding	8	2·8	1·6
I 80 a	6	Bimax. crowding	11	5·0	2·1
I 15 a	6	Bimax. crowding	10	Normal	3
I 15 b	6	Bimax. crowding	10	2·0	2·3
II 7 b	10	Postnormal occlusion	12	3·5	1·7

* Deciduous teeth

I = monozygotic, II = dizygotic; a = first-born, b = second-born

It does not seem as if the exclusion of these cases from *Table I* has affected the results to any extent.

The conclusion from these findings seems to be that most finger-suckers do not get any marked, lasting effect from their habit. This is in agreement with the findings of some authors that there is a definite tendency to self correction of finger-sucking anomalies when the habit discontinues (Lewis, 1930; Kjellgren, 1939; Seipel, 1948 b).

This does not, of course, mean to say that we do not, in some cases of finger-sucking, get such effects. From a prophylactic point of view it may be asked if one should teach all mothers to stop any finger-sucking of their children as soon as it is observed. The fact that the majority of finger-suckers do not seem to be harmed by their habit makes me feel that we should not go so far.

It is impossible to tell if proper feeding and care of the small child could reduce the incidence of finger-sucking. Obviously, everything that can be done along these lines ought to be done, and if this prevents finger-sucking to some extent it might be of some help also for us.

The findings of Klackenberg (1949) and Humphreys and Leighton (1950), indicating that the usage of comforters might reduce the incidence of prolonged finger-sucking, ought to be considered. I am, so far, hesitant regarding the advisability of any general recommendation of this kind.

We will probably, also in the future, have to take care at a later age of a certain number of prolonged suckers that seem to have got a malocclusion that will not correct itself if we do not interfere. This may be looked upon as a defeatist attitude, and I would be interested to hear if anybody has got another opinion on this matter.

9. Early Loss of Deciduous Teeth.—The effect of early loss of deciduous teeth is varying and dependent on such factors as: (*a*) Which tooth or teeth are lost; (*b*) At which

developmental stage the loss occurs; (*c*) The amount of space for the teeth within the arches.

Seipel (1948 a), Breakspear (1951), and, recently, Linder-Aronson (1958) have all studied the effect of early loss of deciduous teeth by comparing left and right sides in cases of unilateral loss. The last investigation may be unknown to this audience, being, so far, published only in Swedish. I would, therefore, like to show the type of curve all the three authors have obtained, by using Linder-Aronson's diagram (*Fig.* 7). It shows, as you can see, that many cases in spite of their unilateral loss (which in the majority of cases occurred after the eruption of the first permanent molars) got symmetric arches. Others, however, show asymmetry in varying degree from 1 mm. up to 7 mm. in the most extreme case.

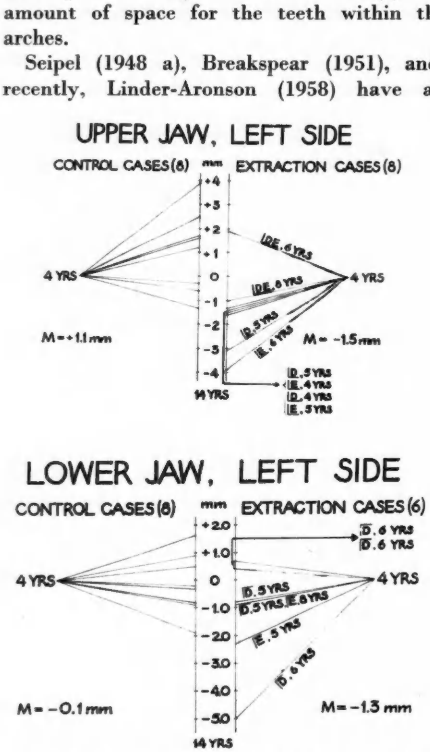


Fig. 8.—Changes in the arch-perimeter from midline to distal of E (medial of M_1) from 4 years to 14 years in cases with early loss (before eruption of M_1) of deciduous molars (Clinch, 1959).

Clinch (1959) found on her extremely valuable material of longitudinal observations that many cases after the loss of a deciduous tooth first showed a pretty large decrease of the arch perimeter but then, gradually, a more or less marked reverse migration as the premolars and canines started and completed their eruption. I would like to present two illustrations showing some of her findings (*Fig.* 8), and at the same time I want to thank her for letting me use her material.

On account of the varying effect of early loss of deciduous teeth, it is very difficult to form an opinion about how much one could hope to reduce the incidence of, for example, crowding if all deciduous teeth could be kept in their full natural size up to their normal shedding stage. Some reduction would be obtained, but perhaps not too much of it.

Another problem is to what extent the overjet or overbite can be influenced by early loss of deciduous teeth. According to Pringle's (1939) observations one might get an increased overbite at 7–8 years of age with loss in the lower jaw. We are, again, most interested in final effects and, therefore, the condition at 13–14 years of age. Personally I could find no such difference in a material of 118 cases (1955).

I do not, therefore, believe that early extraction of deciduous teeth is an important factor in the overjet–overbite variation.

There is a great need of more evidence as to the effect of extraction, as well as abnormal reduction through caries, of mesiodistal diameters of different deciduous teeth at definite developmental stages in different types of cases.

10. Loss of Permanent Teeth.—If extraction of permanent teeth is performed during the development of the dentition, migrations of the neighbouring teeth take place, and result, as we all know, in a varying degree of closure of the gaps.

It is impossible to go into details here as to which consequences can result from various extractions of permanent teeth at different ages in normal and abnormal cases. Our knowledge is also in this respect far from satisfactory. One of the problems discussed in the literature is whether the incisor overbite will be increased by an early extraction of all the

four first permanent molars. Many authors are quite definite in claiming such an effect but very little evidence has been produced to prove it.

One of the latest investigations published is by Lysell (1957), and he could find no significant difference at the age of 14 years in either the overbite or overjet between 18 cases with extractions at 7–8 years of all first

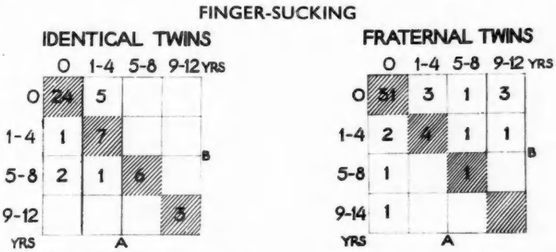


Fig. 9.—Similarity (striped squares) and dissimilarity in finger-sucking in monozygotic and dizygotic twin-pairs. A, First-born twin; B, Second-born twin.

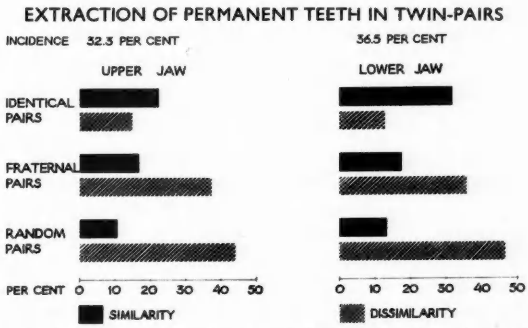


Fig. 10.—Incidence of similarity (concordance) and dissimilarity (discordance) in the extraction of permanent teeth in monozygotic and dizygotic twin-pairs. For comparison the theoretical distribution in random pairs is also given. The incidence of similarity is significantly larger in monozygotic twin-pairs than in dizygotic pairs and random pairs. (Lundström, 1948.)

permanent molars and 23 control cases without any extractions of permanent teeth.

Filipsson (1958) examined profile radiographs of the same cases as Lysell and he could not find that extraction of the first permanent molars had any effect on the general growth of the jaws. Early extraction of other teeth than molars is not so common, which may be the reason why their effect has not been studied in a systematic way. Clinical experience seems to suggest that such extractions constitute only a local influence in the aetiology of malocclusion.

It thus seems rather improbable that the large variation shown in the population in overjet and overbite is due to extraction of permanent teeth to any degree worth mentioning.

11. Trauma and Other Accidents.—In cases of this kind the aetiological mechanism is mostly obvious. Certain types of malocclusion (proclination of upper front-teeth) predispose, of course, for traumatic injuries, showing again the interaction between different factors. In cases of a combination between accidents and other malocclusion it can sometimes be difficult to ascertain to what extent the status presented is a consequence of one or the other type of aetiological influence. This is true especially if some considerable time has passed after the accident until the case is examined.

After this synopsis regarding the effect of different external factors in the aetiology of

malocclusion, I would like to return to the problem to what extent the genetic variability may be due to genetically controlled, environmental factors. That such factors may show a stronger tendency to coincide in monozygotic than dizygotic twins is demonstrated in *Fig.* 9, showing similarity and dissimilarity show to be of a genetic nature. How much we can hope to do this it is very difficult to say. Personally, I do not think we can be very optimistic in this respect, considering that most external factors seem to have a very irregular effect and that their genetic control is only partial.

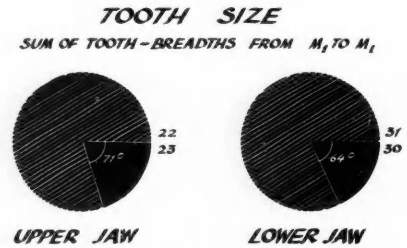


Fig. 11.—Relationship between genetic (striped area) and non-genetic (black area) variability as regards sum of tooth-breadths from M_1–M_1, according to an investigation of 202 pairs of twins. On account of fillings, extractions, hypoplasia of the enamel, non-erupted teeth the calculations are based on only 23 mono- and 22 dizygotic pairs for the upper jaw and 30 mono- and 31 dizygotic pairs for the lower jaw.

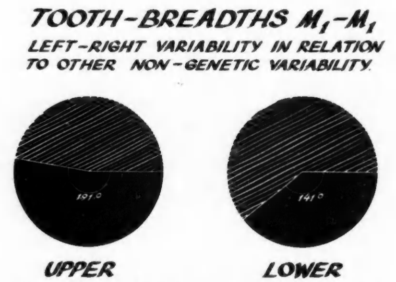


Fig. 12.—Relationship between left–right variability (striped area) and non-genetic variability of a symmetric character (black area) as regards sum of tooth-breadths from I_1 to M_1. The calculations are based on 49 left–right pairs and 23 monozygotic twin-pairs for the upper and 63 left–right pairs and 29 monozygotic pairs for the lower jaw.

in finger-sucking among the two types of twins.

It is very probable that other environmental factors of interest to us are also more equally distributed in the monozygotic than in the dizygotic twins. Dissimilarity as to extraction of permanent teeth is for instance less frequent in the first than in the second type of twins, as demonstrated in *Fig.* 10.

Most probably the same rule applies to extraction of deciduous teeth, which may be one reason why dizygotic twins show more crowding-differences than monozygotic twins.

The general conclusion of these considerations must be that the genetic variability, which we can obtain through statistical calculations on twin-data, is to some extent due to a direct influence on the development from the genes and to some extent to secondary effects from environmental factors which are more or less under genetic control.

Under such circumstances, it must be possible to influence and reduce also that part of the total variability which the twin-investigations

Let us now turn to the non-genetic variability and discuss to what extent we may reduce this through suitable prophylactic measures.

In order to throw some light on this problem it seems best to start with an analysis of the non-genetic variability in tooth-size. The teeth have two advantages over most other variables of the jaws, namely their sheltered position during development, and their bilateral character, which makes it possible to compare not only twin-differences but also the right and left sides of the individual.

The relationship between the genetic and the non-genetic variation of the sum of tooth-breadths from first molar to first molar is shown in *Fig.* 11. The genetic variation is a little more than four times as large as the non-genetic. The question is now: What constitutes this non-genetic variability? In order to get some background to this problem it is of interest to discuss the variation which can be derived from the differences between the right and left sides.

If corresponding teeth on the right and left sides are assumed to be genetically identical, such bilateral differences in tooth-size as can be observed should have some kind of non-genetic origin. It is very difficult to name any definite external influence which could cause a tooth to get smaller or larger than it should be according to genetic control. The most likely explanation of such right–left differences is, instead, that they are an expression of random deviations in the internal environment of the body.

In other words, the precision of the genetic control in a certain external environment may not be absolute, and the final size and form of any organ may, within certain limits, deviate a little in a positive or negative direction from what the gene-combination would, on an average, produce under given circumstances.

It seems very likely that the right–left differences in tooth-size depend, on the whole, on such a lack of precision of the genetic control. If that is so, it is possible to assess for this character to what extent the total non-genetic variability is due to environmental influences with symmetric effect or to a random variation of the same character as causes differences between right and left sides. *Fig.* 12 gives an illustration of such an assessment for the sum of tooth-breadths from first molar to first molar in the upper and lower jaws.

One general conclusion can be drawn from these findings: we can expect to reduce the total non-genetic variability only partly through prophylactic measures. We can never hope to be able to influence these random developmental deviations, which certainly concern not only tooth-size but all other organs in the body. Some of our malocclusions may very well be explained on this basis.

Finally, I will now return to the question in the title of this paper. My conclusion, or perhaps I should say my present opinion, about the answer is probably best illustrated graphically.

Fig. 13 indicates the way a total variability is composed of two independent variations working together. It is also possible to see how much the total variability would be reduced if it were possible to eliminate completely the non-genetic variability. It would obviously give only a moderate reduction. From what has been said in the foregoing we could most probably eliminate only some part of the non-genetic variation through prophylactic measures. On the other hand, it might be possible to reduce also the genetic variation somewhat, in so far as this is due to genetic influences of a secondary nature. Even if this

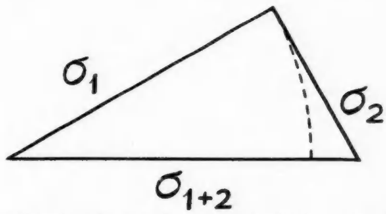


Fig. 13.—Total (σ_{1+2}), genetic (σ_1), and non-genetic (σ_2) variabilities and their relationship to each other according to calculations on twin-data. If a complete reduction of the non-genetic variability could be achieved the total variability would be reduced to dotted line (cf. text).

is so, it does not seem very probable, at the present stage of our knowledge, that prevention, in the true sense of this word, can result in anything more than a fairly moderate decrease in the incidence and degree of malocclusion. Further research is necessary, however, before we can give a more definite answer to this important question.

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DISCUSSION

Miss L. M. Clinch said she would like first to thank Professor Lundström for his very comprehensive survey of what was known, as distinct from what might be vaguely guessed, concerning the causes of malocclusion which it might be possible to prevent. She thought one of the principal functions of the opener of a discussion was to start an argument. In this case it was not easy, but she would do her best.

With reference to the incidence of malocclusion, there was no doubt that orthodontists were in danger of assessing the number of children needing orthodontic treatment as much higher than it really was because, day after day, they saw only malformations. A child with good occlusion appearing in an orthodontic practice was like a good deed in a naughty world. If they went out into highways and hedges and, even better, the orphanages, they would get, she thought, a pleasant surprise. She believed few of them would have thought that lack of space was only slightly more common than too much space at 13 years of age.

Incidentally, she would like to ask what was surplus space? In the upper arch some spacing was essential, she believed, if there was to be no crowding in the lower. Could that be called surplus space?

She would also like to know what Professor Lundström defined as excessive overbite, and why? She could find no difference in the degree of overbite between her extraction and non-extraction cases.

She hardly liked to make any query concerning genetic and non-genetic factors to such an expert on the subject, but some of the slides they had seen showed that, to quote, "non-genetic factors seem to have less influence than genetic in causing deviations from the mean". In what way could the mean, in that connexion, be related to an individual child who might or might not need orthodontic treatment? She understood that the mean was the same as the average, but could they base their opinion on the necessity for orthodontic treatment on deviations from the average? Surely deviations from some standard such as the ideal or the anatomically correct was what should interest them.

She was glad that Professor Lundström did not interpret the connexion between mouth-breathing—or rather between the child who looked like a mouth-breather—and malocclusion as cause and effect. It seemed much more probable that the two anomalies were caused by a third condition, which they were unlikely to be able to influence. That condition, however, often affected the maxilla more than the mandible, resulting in a lingual occlusion of the maxillary cheek teeth. That could be corrected easily in the mixed dentition and a more severe malocclusion, which was much more difficult to correct satisfactorily at a later stage, would be prevented.

She agreed that the ordinary diseases of children were unlikely to have any direct influence on the aetiology of malocclusion, but would Professor Lundström agree that they could in isolated cases cause an alarming increase in caries incidence or that, if they occurred in infants, they could interfere with the calcification of the teeth, making those more caries prone at a later stage, and thus having a possible indirect effect on the occlusion?

Should nothing be done about children with habits which were causing deformities of the dental arches? It had been her experience that in 90 per cent of cases a talk to the child alone, lasting a minute or two, would be enough to stop the habit. She would certainly be loath to abandon that simple procedure, and incidentally she thought it would be fatal to leave the task of stopping the habit to the mother, because children were conditioned to putting up a resistance to "dont's" from their parents and usually just did not listen. A few words from a stranger in strange surroundings usually made a lasting impression. Those who were not impressed might as well be left until a later age anyhow, as they had no intention of co-operating and would be hopeless patients.

One type of malocclusion which in her opinion was often caused by thumb-sucking, and should be corrected early because it was doubtful if it could correct itself, was a crossbite, with the upper molars on one side lingual to the lowers. She would also like to know if Professor Lundström thought that tongue-thrusting might be secondary to finger- or thumb-sucking? In other words, did he think that when the sucking habit produced an open bite the tongue pushed through it? It was known that in swallowing, the sides of the tongue would protrude through a gap where a tooth had been extracted. Was it not possible, then, that the tip of the tongue protruded through a gap between the incisors just because the gap was there? If Professor Lundström thought that was a red herring, there was no need for him to answer! (Laughter.)

She had recently spoken at length about the effects of early loss of deciduous teeth. Would Professor Lundström agree that even if malocclusion were not caused to any great extent by early loss of deciduous molars, a malocclusion which was already present might be complicated to such an extent that a satisfactory result of treatment might be rendered impossible? It seemed to her that it was the children with malocclusion who needed to retain their deciduous teeth to their normal shedding time in order to prevent a more severe malocclusion from developing.

In conclusion, she thought perhaps they were seldom able to prevent a malocclusion from occurring, but they might be able to prevent it from becoming more complicated, and she would like to know if Professor Lundström would agree with that.

The Chairman opened the meeting for general discussion.

Mr. Robertson Ritchie said he had understood Professor Lundström to say that in the cases of asymmetry, in other words differences in width between molars of either side, it was likely to be due to non-genetic factors. Need that be necessarily so, since facial asymmetries could be inherited apparently?

Would Professor Lundström say that the conclusion from his findings was that the use of space-maintainers would not be necessary, or was that a misinterpretation of his feelings on the matter?

Mr. E. K. Breakspear said it was many years since Mr. Pringle had studied the effects of early loss on the overbite and overjet, and most people who had studied it since appeared to have come to the conclusion that it did not make very much difference. He was one of the people who were not satisfied that such was the case. He did not know at that moment whether it did or not, but he would like to point out some of the possibilities which might make the other results not quite so straightforward as might at first have appeared. He would be glad of Professor Lundström's comments.

He had a theory, which he had mentioned at the last meeting, that the effect of "double extraction" of deciduous teeth (i.e., extraction of two adjacent deciduous teeth) was different in kind from the effect of single extraction. He thought it was most important to separate the double from the single extractions, and not mix them up together. One of the things which could happen was that the tongue could get into a large space and act as a space retainer, but it could not get into a small space.

In Miss Clinch's cases which have been shown, he had noticed that where the upper D, E together had been extracted, the loss of space had not been nearly so great as it had been where the single D or the single E had been extracted. They had not been shown any cases of double extraction in the lower arch, and so had not been able to see if that had also applied at the bottom.

Professor Lundström had, however, shown the effect of bilateral lower deciduous extractions. He thought it was probable that when a number of such cases were taken it would be found that a large proportion of them had bilateral loss of all four D's and E's. He thought that was more common in the lower arch than in the upper, and it might affect the results and give an impression of fewer defects than might really be the case if they could be analysed. He also thought that if all the lower D's and Es' were lost, some cases might have a collapse of the lower arch backwards and others might acquire an artificial, pre-normal occlusion. If all those things were to be lumped together in the same survey they might cancel each other out and give the impression that no harm was done. In actual fact they might each have a definite kind of harm in the opposite direction.

Was it possible that there was a difference between Swedish and British material? He had had the impression when in Sweden, that there were more pre-normal cases there than here. That might alter the apparent effect and he would like to have comments. He had enjoyed Professor Lundström's paper immensely, and thought it extremely valuable.

Mr. J. H. Hovell said he had been very interested in the paper. It showed how an eminent orthodontist from another country had possibly the same views as many orthodontists in this country.

The paper had indeed shown that the majority of malocclusions, as seen in orthodontic practice, were in fact a combination of a number of variations. He would cite the paper as putting another nail in the coffin of the "pathodontist" [Mr. Hovell's term for orthodontists who think malocclusions are due to pathological interference with growth] and leaving orthodontists to real orthodontic thinking.

Mr. Robertson Ritchie had raised one point on which he had been about to take issue. He thought the whole argument on the fact that two sides could not be a genetic variation was based on a false premise that the body was geometrically symmetrical. It was not, certainly in the thorax, abdomen, and pelvis. They could very well demonstrate the hereditary, unilateral asymmetries which could be present in teeth, and facial skeleton, and other minor details which were not really noticeable.

Mr. W. J. Tulley said the twin material from which Professor Lundström's paper had been derived was unique.

He had noted that the author had not commented on the soft tissues, which he had thought was very tactful.

Had Professor Lundström observed from his material any evidence of lisping in the speech of dizygotic, or uniovular twins, and had it occurred more frequently in the uniovular or the dizygotic twins?

Mr. R. E. Rix said that, as they had expected, the meeting had heard some very interesting facts.

While he would agree entirely that the extraction of the four first permanent molars left the overbite at long last about where it had been before, he felt that an impression might get around that one could take either the lower or the upper pair out and still leave the same degree of incisor overbite. He thought, however, that it could make a difference if one pair, say the lower pair, were extracted, leaving the other pair.

Would Professor Lundström please comment on that?

Professor Lundstrom, replying to the discussion, said he hoped he would be able to manage, in what was to him a foreign language, to answer the questions satisfactorily.

Miss Clinch had asked how surplus space was defined. It was merely a question of measuring the arch perimeter and then the sum of the tooth-breadths, and then the difference between the two. If the arch perimeter were larger than the sum of the tooth-breadths, the conclusion would be arrived at as it had been defined in the diagram. In the upper jaw the figures were reduced by 1 mm. as cases with even dental arches (no crowding or spacing) showed, on an average, a space-difference of +1 mm. in this jaw. He had to admit that that type of measuring might possibly be a little misleading. The errors, however, would be comparatively small and would not affect the general distribution much.

He had also been asked what was an excessive overbite, and of course he could not say where the dividing line was to be placed. He had mentioned in his paper the standards used by Seipel in a classification of overjet and overbite, but he thought perhaps one was apt to say that treatment should be considered with an excessive overbite at the level of 5 or 6 mm. It was very difficult to say. He had not wanted to take therapeutical problems into his paper.

He had also been asked why he had used deviations from the mean, and not as mentioned from the ideal occlusion. The reason was statistical, and it was a way of determining the standard deviation. What he had been interested in was the variability as such, and if the variability were due to genetic or non-genetic factors. In that case it would not really have been any advantage to use the ideal occlusion instead of the mean.

Regarding illness causing caries, and then extraction of deciduous teeth which cause malocclusion, he thought that might be a possibility. The ordinary children's diseases, however, were too short to have that effect really, but it was not something he had studied.

Miss Clinch had said that 90 per cent of the cases which she had had with finger-sucking could be dissuaded from the habit by a short talk. He would certainly congratulate her on her influence. He had himself had difficulties with many of these cases, but perhaps Swedish children were more stubborn than English children. (Laughter.)

Another question had been posed regarding the early treatment of crossbite in the finger-sucking cases. He would have thought it was an advantage to get in early, as Miss Clinch had suggested.

He thought it was extremely likely that a space would induce tongue-thrusting to some extent, but, on the other hand, the finding that most of the finger-sucking cases had not shown any difference in overjet—and he had not seen it in overbite either—had seemed to show that perhaps not too many of the cases were harmed from tongue-thrusting a bit after the finger-sucking. The extreme cases were not, of course, included in a study such as he had presented, and they were those which were seen by them as specialists, and there was surely that factor in some of the cases.

He had been asked whether the differences in tooth-size between left and right sides were not non-genetic but genetic. Of course there were genetic asymmetries, and it was very difficult to say definitely that the left–right differences observed could not be of that type. He would not like to be dogmatic about it, but on the other hand he found in the twins that the bilateral differences were not systematic in their nature. There were instances of the central incisor having the larger tooth on the right and, in the same case, the canine perhaps could be the opposite. There seemed to be a random distribution of the left–right differences over the teeth in the same case, and that he thought indicated that it was not a genetic question but a random variability.

Regarding the comparison of double and single extraction, as mentioned by Mr. Breakspear, he was unable to answer that fully because he had no good material at hand. There was some material, but he had not thought of it enough to investigate it especially. He did not believe that his material would show such a tendency as a general one which perhaps would not be expected because there were so many factors which came into effect of an extraction of deciduous teeth. There was, for instance, the general development of the arches. Miss Clinch had shown that that factor was one of some importance and it would therefore probably not be possible to get a universal indication of that type. It might very well, however, be a factor and he would be very interested to learn more about the findings which Mr. Breakspear would get in the studies which he was doing.

He had not taken soft tissue into his paper because he had not studied it. It was very difficult in twins to get any objective valuation of soft tissue and of habits. He had not, he was afraid, investigated the lisping tendency which was asked about.

Mr. Rix had said that extraction of 4 molars must be looked upon in another way as compared with the extraction of 2, especially in the lower. Mr. Rix of course was quite right.

The Chairman said that Professor Lundström had prepared his paper, as he did everything, with meticulous care. It must have been doubly difficult for him because it had been done in what was to him a foreign language.

It had been a model paper, and had cleared up a number of points which had been mere speculation before. The meeting was greatly indebted to Professor Lundström for coming.

On behalf of the meeting he would like to thank Professor Lundström for his paper and Miss Clinch for opening the discussion.

The Chairman then declared the meeting closed.

Teeth of 5-year-old London Schoolchildren

From a survey, carried out in 1957, of the dental condition of 5-year-old schoolchildren, the following observations have been made: The caries picture has shown little or no change since 1955. There have been many variations both in structure and in caries experience of this age group since the original 1929 investigation. The structure of the individual teeth has varied from year to year. The better the structure of a tooth the less likely is it to become carious. The incidence and extent of caries declined from 1943 to 1947, but rose after that date until 1955, since when there has been little or no change. The proportion of carious teeth filled has increased from approximately 2·5 to 11 per cent since 1943. The percentage of extraction was also greater in 1955 and 1957 than at any of the previous inspections. There was marked improvement of the caries picture between 1929 and 1947, which is attributed to more scientifically controlled nutrition of pregnant women and infants during the war and post-war period of rationing. The subsequent free choice of diet when cheaper foods including cereals were more easily obtainable, together with the reduction in the consumption of milk and cod-liver oil, could account for some of the deterioration from 1947 to 1955.—MELLANBY, M., MARTIN, W. J., BARNES, DAVID (1958). *Brit. med. J.*, **2**, 1441.

Dermatitis in Dentists

To the question "What are the common causes of dermatitis of the tips of the fingers in a dentist?" the following answer was given: The commonest cause is allergic sensitiveness to contact with local anæsthetics, but all other contacts in dentistry should be considered, such as antiseptics, antibiotics, nickel, chrome, oil of cloves, amalgam, acrylic resin, etc. In a recent case of this type the problem was not solved until patch-tests had extended to the home field and incriminated a streptocarpus plant.—*Brit. med. J.* (1958), **2**, 1546.